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The Transmission of Electricity for Electric Railways.

THE USE OF THE RAILS AS TRANSMITTERS—THE ISOLATION OF THE RAILS—AIR-LINES WITH CONTACT MOTORS—MATERIAL FOR SUCH LINES—THE CONTACT MOTOR—OTHER SYSTEMS FOR ELECTRIC RAILWAYS—FORMULÆ FOR LINE DEFLECTION AND FOR THE TENSION OF WIRES—GENERAL CONDITIONS OF CONSTRUCTION—DIVISION ACCORDING TO THE NATURE OF THE CAR BODIES—DIFFERENT CAR CONSTRUCTIONS—DISTRIBUTION OF THE SEATS—WHEELS, AXLES, TRUCKS, BODY OF WAGON, DIMENSIONS—TRANSMISSION OF ELECTRIC POWER FROM THE RECEIPTOR TO THE WAGON AXLES—TRANSMISSION OF ELECTRICITY IN THE WAGON—PRODUCERS OF CONTACT.

[Translated for the New York ELECTRICAL REVIEW, from Krämer's *Die Electrische Eisenbahn*, by Franklin H. North.]

In the first electrical railway the rails were used to carry the current, the one the negative, the other the positive. Two of the car wheels isolated from all other iron portions of the vehicle served to conduct the current to the dynamo machine on the car. On the motor were contact closers by which the current was managed. By these contact closers the break could also be used, but this was only resorted to under extraordinary circumstances, because such use always resulted in a severe shock to the machines. In what is about to follow, the advantages and disadvantages of using the rails for the conduct of the current will be discussed.

As a matter of fact, even up to the present time, Messrs. Siemens and Halske have not yet decided as to just what is the best and most efficient means of using the rails as a current conductor. It may be said to be a problem which is yet to be solved.

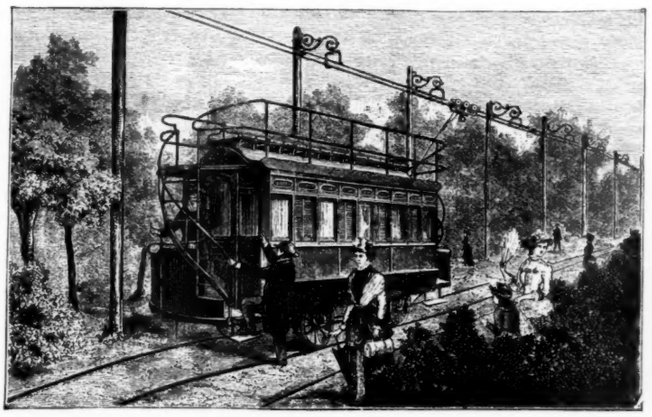
The use of the rails, however, for this purpose is always to be commended where throughout their whole extent they are nowhere exposed so that they may be touched by the public. In elevated roads or in tunnels this description of electric railway is likely to prove most advantageous. Though currents of high tension are never used in this description of road—the Lichterfelder railway, for example, is said to be 90 volts—nevertheless, the occasional production of extra currents make the rails a constant source of danger to men and animals. Horses, even, if not seriously injured, are apt to get so severe a shock as to make them unmanageable.

The rails, having a large cross-section, do not offer much resistance to the electric current. On the other hand, they have many corners and curves whereby differences in tension are produced, and losses of electricity result. These losses are the greater as the isolation becomes less perfect. Attempts to completely isolate the rails would present special difficulties.

In the Lichterfelder railway the rails are said not to be well isolated, and a regular transfer is possible. This question of isolation is one of the most important problems in this description of electrical railway. The shape of the rails, the weight per meter, the underpinning must be well and carefully considered.

The author is now considering a project for an electrical railway 8 kilometers long of this character in which Vignole's rails weighing 12 kgr. are to be used. The wagons are to be very light, being intended to accommodate only twelve people each, and the road is but one meter wide. The entire road is to be so protected that the public will not have access to the rails.

The rails will be laid on soft ties, and a direct connection between rails and ties is prevented by layers of gutta percha linen. This gutta percha is of such a thickness that how much soever the wheels press upon it from heavy laden cars, they will not suffice to destroy its efficiency. The direct touch of the spikes with the rails is prevented by a similar means.



It is not to be denied that this scheme of isolating the rails is an expensive one. But even this cost will not prove so important as that which, as will be later on explained, may be looked for in guarding against the same danger when the current is transmitted by means of su-pended wires.

Besides this, it should be remembered, that in using this gutta percha linen under the rails, a saving of power is obtained which more than compensates for the extra expense. Thick cables leading from the generators and buried in the ground serve to convey the supply of current to the rails.

So far as the rails are concerned, it is better to use screw-headed bolts to fasten the rails to the ties, for these may more easily be isolated.

This isolation will be even more simple if the "chair-rail" system is used, in which the rails are supported upon metal chairs, and do not, save at these points have any connection with the road-bed. To prevent bending of the rails, even where cars carrying forty-six passengers are used, it is only necessary to use five or six of these chairs for a seven and a-half meter rail. As will be readily seen, the making of these five or six isolations will be much cheaper than in isolating the entire rail. These chairs may be laid upon gutta-percha linen, or hickory wood may be used, as in America. A perfect isolation could be had if these chairs could be made out of hard glass, as Siemens proposes. Hard rubber too will be found, though equally as good as the gutta-percha linen, very much cheaper.

In this description of railway the wheels which are not used to connect the motor with the current, must be carefully isolated. In regard to the resistance of rails, there have been no exact figures published, and theoretical calculations are, in this case, of little value, as the bases to be reckoned from are valuable only when the most cylindrical and prismatic bodies are concerned.

As soon as the use of the accumulators for electric railways find more general application, all these difficulties which are begotten of transmission of current will, of course, be done away with.

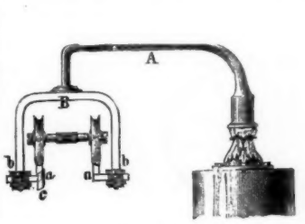


FIG. 1.

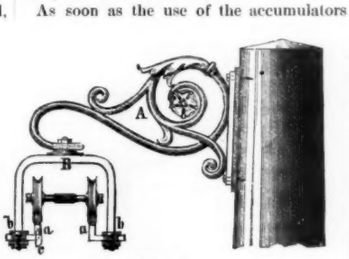


FIG. 2.

Aside from the electrical railway (elevated) and under such conditions that the public can be protected from the current in the rails, the best form of electrical railway is that by which the current is transmitted by means of a small contact-motor which runs upon rails overhead, these rails being supported by poles, and the electricity being brought from this contract-motor by a small cable connecting the contact motor with the dynamo on the cars.

Even this system, however, has its peculiar difficulties. One must remember that it is necessary to choose a material of the very least possible resistance to transmission. It must too have the minimum tendency to oxidize and the coefficient of expansion in the different temperatures must be very small The first of these conditions is easily explained by what has been said about the electrical transmission of current. The inconveniences of oxidation will be apparent when one considers that from every part of this line the electricity is deflected by the contact-motor which rolls over it. Therefore a contact causing the least resistance between the line in its whole length and the contact-motor is the most desirable. Furthermore, if the expansion of the line in higher temperatures is greater, the irregularities in the expansion in separate parts of this line cannot be rectified. Thereby, one gets not only troublesome interruptions of the wires, but also interruptions of contact can be caused during the passage of the contact-motor, whereby the generation of sparks at the deflection, on the other side, irregularities of speed and uneven movements of the machine cannot be avoided. To produce a good line, in which all the aforesaid faults are corrected, has not been successful up to date, This is yet in the domain of uncertainty. Although Siemens has used copper for such lines, Weiller's phosphor-bronze and Weiller's silicum copper wire are more to be preferred, because the alloys of the copper diminish the power of oxidation of such wires very much The resistance becomes greater on account of this.

On the other hand the toughness is greater, a great advantage, especially with electrical railways where the line is exposed to mechanical influences. The following table shows the proportions of the aforesaid :

Diameter of Wire.	Resistance. In Ohms.			Toughness. In Kilogrammes.		
	Pure Copper.	Phosphor-Bronze.	Silicum-Copper.	Pure Copper.	Phosphor-Bronze.	Silicum-Copper.
In Mm.						
1	23 3	76.4	38.1	21.1	70.2	55.6
1.25	14.8	41 6	22 2	34	112	87
2	5.8	19.3	9.5	88	282	219
2.5	3.7	10.2	5.1	137	441	343
3	2.5	8.4	4.2	197	636	494
4	1.5	5.6	2.4	352	1131	879
5	0.9	3.0	1.5	549	1766	1374

Although one could make use of the earth in lines of electro-dynamic machines and in electric railways, one has until now, when very strong currents are used, made use of double wires with the exclusion of every earth connection, and also with the electric railway a double line is to be preferred, the one from the positive, the other from the negative pole of the generator.

The author has a project for a street railway where the use of the air-line was easily possible. He has projected the following line, and has made experiments which resulted in a satisfactory manner. Wires of silicum-bronze are to be used 6½ mm. thick; the resistance of which will be .47 ohms per thousand meters. With this wire it was possible to have spans of twenty meters. It was nevertheless decided to have the poles fifteen meters apart. The figures 1 to 5 show the mode of suspending, in which it is necessary that the contact motors while rolling along the wires should not meet with any impediment at the pole-supports. The cast-iron carriers are screwed in the poles, and if one wants to be very careful, the direct contact between the carriers and the poles may be prevented by a layer of gutta-percha linen will be of great value in the bad places of the isolation of the line. The wire supporters *a*, are perfectly isolated by hard rubber, or hard glass, *b*. The wires are now fastened by screw-headed bolts on *a*, and it will be well to give these wire supporters the same thickness as the transmission wires, and they should also be quite long to give the wires proper support. It would also be well to give the wire-supporters a saddle-form curvature, because of the easier movement of the contact-motor. If one wishes to protect the line against the earth-contact, and with such strong electric currents, one can hardly do too much. The stirrup, *b*, can also be isolated from the point, *a*, without difficulty, and with little additional cost by layers of hard rubber. The supports, *a*, on the railside are served on both sides with metal pieces bent outward and forward. These pieces of metal are for the purpose of catching the cable by which the contact-motor is drawn and to facilitate their gliding through. Figure 5 shows a supporter for a two-rail road, where it is supposed that the two inner supports, *a*, are serving for wires for the same poles, and it is therefore sufficient if only the two other wires are isolated from the inner one and from one another. Figures 6 and 7 show the contact wagon which is suitable for the prescribed lines. This one is planned with three axles. The axles run in the frame *r*, which extends far under the lines to prevent the derailment of the contact-motor, and if derailed, to make short contacts impossible. Also to facilitate the adjustment of the contact-motor in the line. The wheels, *A*, made of silicum-bronze, have either half-circle or sharp angular gutters with which they take the wires, *a*, on the running rim, and so produce the contact. These gutters may be a little deeper than the figure shown so that the flanges go further under the wire and therefore diminish the danger of derailment.

The construction of the axle is easily to be seen from figure 7, as every connection between the two transmission wires in the contact wires must be made impassable. Every axle will be made out of an isolating material in which the metallic prolongations, *b*, will be screwed in as axle-shafts. One may use for material hard rubber for isolating piece, *B*, and envelop the same in such a way with bands of metal that the ends to an extent of six mm. will be free of metal.

We will now discuss the deflection of the electricity from the contact-motor to the car furnished with the receptor. From the axle-shafts, *b*, a two-armed metallic fork, *C*, is suspended, the arms of which are also isolated from each other. This fork is not stationary, but has a small angular motion at the axle to follow the direction of the train. At the arms of the fork the ends of a two-veined cable are screwed, so that now the perfect contact from the wires to the wheels; from there to the axles, and over the arms of the fork, which is here suspended to the cable and into the rolling-car, is produced. As all wheels on one and the same side are in transmitting connection with each other by the frame, *R*, the sure contact between wires and contact-motor is beyond doubt; the more so as by the weight, *G*, which is movable in two directions the equipoise of the contact-motor was put far under the wires. This obviates, in case of some irregularities in the horizontal plane of the wires, the derailment of the wagons.

The weight must be suspended in the fork, of course completely isolated. If one wishes

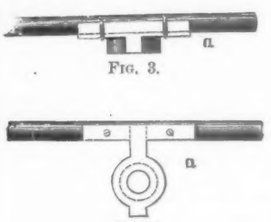


FIG. 3.

FIG. 4.

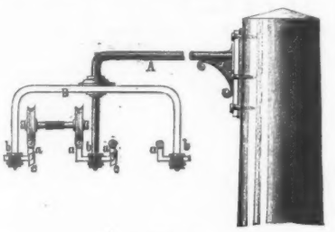


FIG. 5.

to give the contact-motor a still greater stability on the wires, we can give the same four or even five axles. It must always be taken into consideration, though, that the equipoise is in the center line. It has also been proposed to draw the wires vertically, the one over the other. Furthermore, to use three-wheeled contact-motor axles, and in consequence three-wired lines, whereby the middle line would only serve as support for the greater security for the contact-motor.

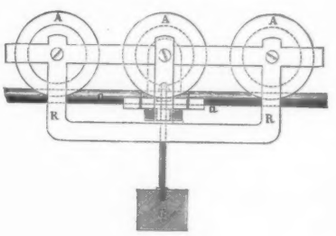


FIG. 6.

There are no experiences to practically assist any of these suppositions, and it will be the object of the experimenters, of whom there are naturally not many, to give the most practical solution of this problem.

We will also refer to the experiment of placing the line or lines between the rails in uncovered canals. Thence they are taken up as the motor passes along, and dropped again after the completed contact. This system, however, has not produced a satisfactory result, nor is likely to do so.

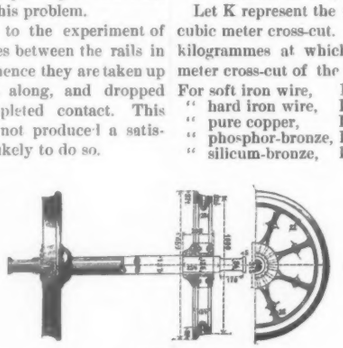


FIG. 8.

The first fig. shows the arrangement of an electric railway with the contact-motor traveling overhead. The firm of Siemens & Halske, to whom we are indebted for nearly all the experiments and the systematic collection of data, produced at the International Exposition of 1881, the line of an electric railway made of pipes of 25 mm. diameter in which small contact rolls glided of convenient size. There were, however, frequent interruptions, especially at the points where the pipes joined. The whole arrangement did not impress one favorably. Therefore the above-named firm has made use of small rails instead of pipes for the electric current in the electric mine railway at Zankerode near Dresden.

These small rails have been suspended, isolated on T-irons, and over these rails the contact-motor taking the current rolls over these rails in a manner not essentially different from that of the silicum-bronze lines already described. This arrangement is said to prove efficient. One may object to the form of the cross-cut of this electric line, because such a line having the same material and with round cross-cut offers in every case less resistance.

A Ehrlich in Berlin proposes to fasten the lines on the rails and carefully isolate them in this position and to conduct this line to the receptor by contact-rollers. This idea has certainly some advantages. The proposition of Mr. Ehrlich seems, however, to be not only complicated but expensive, and it will be necessary to make many changes in it to make it efficient. It remains to further amplify what has been already said concerning the building of electric lines for railways.

Let γ be the weight per cubic meter of the material expressed in kilogrammes.

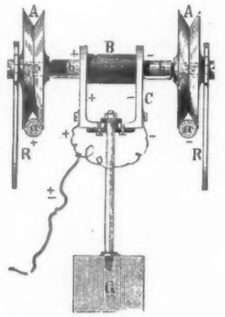


FIG. 7.

This would be for—

Cast iron,	$\gamma = 7.788$	kgr.
Copper,	$\gamma = 9.000$	"
Phosphor-bronze,	$\gamma = 8.930$	"
Silicum-bronze,	$\gamma = 8.900$	"

Let K represent the absolute strength per cubic meter cross-cut. That is the weight in kilogrammes at which a rod of 1 square meter cross-cut of the material is torn apart.

For soft iron wire,	K = 44,000,000	kgr.
" hard iron wire,	K = 60,000,000	"
" pure copper,	K = 25,000,000	"
" phosphor-bronze,	K = 110,000,000	"
" silicum-bronze,	K = 118,000,000	"

$n = 1, 2, 3, 4, \ldots$ a figure which shows the degree of security against being torn apart at the highest grade of tension. Therefore at the lowest temperature (-25°). Let t be the difference in temperature (C°) at the time of the wire tension ($+10^{\circ}$) above the existing lowest temperature. Let a be the coefficient of expansion of the material per degree C; for example,

Cast iron,	$a = 0.00001182$
Copper,	$a = 0.0000172$
Phosphor-bronze,	$a = 0\ 0000170$
Silicum-bronze,	$a = 0.0000171$

Let e be the span in meters.

Let h be the deflection at the lowest temperature.

Let h_2 be the increase of the deflection at a temperature of t degrees.

$h = h_1 + h_2$ the whole deflection at t° above the lowest temperature. Then the value of h and h_1 must be ascertained according to the following formulæ for the smaller spans which occur in electric railways:

$$h_1 = \frac{e^2\, n\, \gamma}{8\, K} \quad \ldots\ldots \quad 1$$

$$h = h_1 + h_2 = \sqrt{3\tfrac{6}{8}\, e_2\, a\, t + h_1\, 2\,(1 + a\, t)} \quad . \quad 2$$

The value of n can put equal to 4 in the practical application of these formulæ.

Thus—

For copper wire, $h_1 = 0\ 00018\ e^2$

" hard iron wire, $h_1 = 0.0000649\ e^2$

It is the more necessary to find out the exact deflection of lines for electric railways, as the influence of difference of temperature is proportionately greater with small spans and small deflection than with large spans and large deflection.

If the points of support are not on the same plane, and the differences of height are not too great, the formulæ 1 and 2 may be applied unchanged, but the deflection h is then the perpendicular difference between the straight line connecting the two points of support, and is situated more or less away from the center of the span toward the lower point of support. If we use the aforesaid values we have—

$b = \frac{e}{2}$ half of the span in meters.

l half of the bend in meters.

G the weight of half of the bend of the wire and at the same time the vertical tension in each of the points of support expressed in kilogrammes.

H_1 the horizontal tension of every point of support.

S_1 the maximum tension of every point of support.

a the angle at the end of the bend.

m the value of $\frac{K}{n\gamma}$ and in most cases $\frac{K}{4\gamma}$

We have—

$$l = b + \frac{2h_1^{\,2}}{3b} \quad \ldots\ldots \quad 3$$

$$h_1 = m - \sqrt{m^2 - l^2} \quad \ldots\ldots \quad 4$$

$$H_1 = \frac{b}{2h_1}\, G \quad \ldots\ldots \quad 5$$

$$S_1 = \frac{\sqrt{b^2 + 4h_1^{\,2}}}{2h_1} - G \quad \ldots\ldots \quad 6$$

$$\text{tang. } a = \frac{2h_1}{b} \text{ or also} = \frac{2lh_1}{l^2 - h_1^{\,2}} \quad \ldots\ldots \quad 7$$

For the increase h_2 the degree of bend of the wire curvature of the degree of curvature h_1, the span e with an increase of temperature of t° C and the coefficient of expansion a of the material one receives about

$$h_2 = 0.00000887.\ l\frac{b}{h_1}\, t \quad \ldots\ldots \quad 8$$

The choice of construction for the wagons to be used in an electric railway is dependent in the first place upon whether the road is to be used for the transportation of great masses of people at certain times of the day, or whether it should be possible to transport smaller groups of passengers at certain intervals. For example, if an electric railway is built in the neighborhood of a large city to any place of amusement or popular resort or to a very much frequented depot, it should be built accordingly. With a street railway in a city of the second or third class, it will be better to use cars of smaller capacity which will necessitate a greater number of wagons than in the first case.

Electric railways used for the transport of goods must necessarily be made with reference to the goods to be transported. Cars for passenger transport should be built similar to those used on the regular tramways. The steam carriages, such as are used on the regular railways, are not to be recommended for use on electric railways because the dead weight of such cars is an unnecessary draught. Cars for electric-railways should be constructed according to the following rules:

1. Small weight with sufficient strength of build to bear ordinary usage.

2. The greatest possible carrying capacity and with economical distribution of room.

3. Practical distribution of weight when empty and when loaded.

3. All parts should be easily accessible for repairs and examination.

In the following lines the railway cars will

be spoken of as a whole and in their various parts.

There are open, half-open and entirely closed, and two, three and even four axled cars. These have one and sometimes two stories. They are either furnished both with side and longitudnal seats, and the various parts of the car may be made more or less luxurious, according as it is desirable to have one class or several.

Figs. 93, 94 and 95 show views of a two-axled wagon having places for eighteen passengers, with two platforms similar to those which are used in the Vienna tramway. The weight of such a car is 2250 kilogrammes.

Figs. 96, 97 and 98 give a view of a two-axled wagon with accommodations for 20 passengers, having two platforms and a middle aisle, weight 2300 kilogrammes. This wagon has longitudinal seats, while in the other they are cross-sectional. The entrance and exit of the one is in the center, and in the other is at the ends. These two kinds of cars will be found more convenient where there is not a rush of passengers, and are more serviceable in the regular traffic between two points.

For the transport of great masses of people the car shown in Fig. 99, having imperial seats, is more adaptable. This contains forty-six places, and weighs 2800 kilogrammes. Of course, this is not calculating the electric attachment. These three descriptions of cars are intended for a normal width of track.

It will be profitable with most electric railways to make use of so-called entirely closed cars, and to arrange it so that the windows may be entirely removed on hot days, or at least let down. Care must be taken to have shutters at the open places in the car to give shelter when necessary.

The profitable use of the space at command should be the main object of the constructor. The number of places is indefinite according to the use of the railway and the condition of the traffic. It may range between twelve and forty-six. Cars having only one story, made for a normal width of track, should never have below sixteen nor above forty-six places.

There are cast-iron wheels with spokes and hollow They may be hard cast, centrifugal cast, iron cast and steel cast, and also there are those composed of wrought and cast iron together. In the composite wheels the outer circle is often composed of wrought iron and the main body of a cheaper material and other combinations have been proved efficient. For electric railways the use of wooden or paper pulp is to be commended because it is often necessary to isolate the car from the rails against the electricity line, which can be best effected when these wheels are used.

In these wheels the space between the cast-iron, or the steel and the inner ring surrounding the axle and made of the same material, should be composed of hickory wood, or of paper like those used on American steam railways.

This manner of making wheels not only adds to the stability, but also adds to the smoothness of the car's movements and also serves to completely isolate the car.

The diameter of the wheels may vary between 750 and 850 milimeters. The most important part of the wheel is the outside flange. Fig. 100 *a*, shows profile of such a wheel, of a conical wheel, which is preferred to that of a cylindrical form, Fig. 100 *b*. The angle of the plane of running varies between 1 to 35, and 1 to 10. The ones of 1 to 16 would be the best.

The profile of the flange of the wheel must accommodate itself in general to the rails used. If the rails in electrical railways are used as transmitters of the current, it is desirable to have the top of the rail as well as the plane of running of the flange of the wheel as broad as possible. The greatest width of the plane of running of the wheels in ordinary use is 135 millimeters, and the smallest 32.

The weight of a wheel varies between 49 and 220 kilogrammes. Every two wheels are connected by an axle of steel, Fig. 101; the usual diameter of these axles is from 70 to 130 millimetres at the shaft, and in the other part from 50 to 90. The thickness of the axles is in direct proportion to the weight. The shafts run in journals which are made of "red-cast" or bronze, sometimes also made out of white metal. The proper oiling of these journals must be carefully looked after, and if these wheels be used for the conduct of electricity, it is necessary that the journals should give a contact with resistance between wheel and axle.

A separate connection is, in this case, to be commended between the flange and the axle.

There are 2, 3, and 4-axled cars. The axles are either to be immovable with regard to each other, and also made so that they shall be vertical to the curves of the rails.

As the best means for the transmission of electric power from the receptor to the car-wheels has as yet not been found, the immovability of the axles must be chosen for electric railways. To make it possible to have more sudden curves, it is necessary to make the distance between the axles rather short, and to only take 2-axled cars for use on electric railways.

The truck is either made of wood or of iron. (See Figs. 94 and 97). As it is necessary to bring the dead weight to a minimum in electric railways, we will without doubt choose wood, and if two-storied wagons are chosen for transporting masses of people, the use of iron railings and iron guards on front and rear is to be commended.

The lengths of the wagons vary between 3.140 to 13.400 meters. The width of the wagons between 1.530 meters to 3.100 meters. The inner height of the body in the center between 1.880 meters to 2.500 meters. Measured at the sides, between 1.658 meters and 2.050 meters. The entire height above the rails with one-storied wagons between 2.550 meters and 3.375 meters. Two-storied wagons, between 3.450 meters and 4.900 meters. The height of the platforms between 0.4 and 1.25 meters.

To facilitate the smooth running of the wagons, the best proportions between the length of the wagons and the distance between the wheels is 1.33.

The proportion of the width of the wagon to the width of the track varies from 1.25 to 2.40. The weight of the wagon varies between 1,070 and 11,300 kilogrammes. The proportion of the number of seats to the weight of the wagon should never be more than 1 to 60 or to 80. The minimum weight of the wagon furnished with the receptor and the distance of the wheels can be found only after considering the gradients, the sharpness of the curves, the maximum load, and the required speed. According to formula 1 it is—

$$p = M\left(\frac{1}{r}+\frac{1}{n}\right) + T\left(\frac{1}{r}+\frac{1}{n}\right) + Z\left(\frac{1}{r}+\frac{1}{n}\right)$$

and as

$$P = \frac{D}{m} = \frac{M}{m}$$

and as furthermore

$$\frac{M}{m} = T\left(\frac{1}{r}+\frac{1}{n}\right) + Z\left(\frac{1}{r}+\frac{1}{n}\right)$$

therefore the weight of the wagon is

$$M = m\left(T + Z\right)\left(\frac{1}{r}+\frac{1}{n}\right) \quad . \quad . \quad . \quad . \quad 1$$

This result shows also how much weight each axle must sustain, and we can therefore calculate the necessary thickness of each axle.

The distance of the wheels from each other, A, is found from formula 9:

$$A = 4\left(\frac{2g\,R}{v^2}+\frac{K}{M}-1\right) \quad . \quad . \quad . \quad . \quad 2$$

The City Council of Evansville, Ind., has given the local company a five years' contract to light the city with ten towers of four lamps each, 100 feet high, fourteen arches, fifty feet high, across the intersections of streets, each with one lamp, and two masts bearing lights.

The Electric Light.

IS IT DRIVING OUT GAS AS AN ILLUMINATING MEDIUM?—THE WONDERFUL PROGRESS MADE IN ITS USE IN THE LAST TWELVE MONTHS—LIGHTS EQUAL TO 150,000 GAS JETS NOW IN THIS CITY.

The growth in popular favor of the electric light in this city lately has made the hearts of enemies of the illuminating gas throb with emotion, and probably caused many persons interested in electric light companies to remain at Saratoga or Atlantic City longer than anything but extraordinary circumstances would warrant. Miniature moons on carbon points, held captive in glass globes, have for many months shone nightly in Chestnut street stores, but now they are gradually finding their way into more remote quarters. They surprise pedestrians by suddenly looming up in hidden and unsuspected thoroughfares.

There are four large electric light companies in this city, besides a few agencies of small concerns. Two of these former—the Brush and the Maxim—from their own engines supply direct to consumers. The Edison and the Thomson-Houston companies, on the other hand, do not distribute the light, but fit up machinery on the premises of their patrons. Large lights similar to those placed along Chesnut street by the Brush Company, which, it will be remembered, surprised the city by giving it a free electric light, are charged for at the rate of from seventy-five cents to one dollar each per night. The rate charged is according to the number of lights which the consumer employs and the length of time for which he will contract for the supply.

EQUAL TO 150,000 GAS JETS.

It is calculated that the electric light used in Philadelphia nightly is equal to from 130,000 to 150,000 gas jets, each consuming six and a half cubic feet of gas per hour. It must be borne in mind, however, that electricity has not supplanted this number of jets, as in every case in which it is used the light given is two or threefold greater than that enjoyed under the gas system. There are prophets bold enough to predict that ere long a certain twelve men elected by councils to see that the city is illuminated will be known as the "Electric Light Trust." The real authorities, however, while not quite so hopeful as this, are loud in their assertions that gas will gradually be shouldered out of the market, and that even now it shows many signs of yielding.

A. J. De Camp said yesterday that the Brush Company, of which he is secretary, could not receive any more orders for illumination, as the works are running their full capacity. "To produce more electricity," he said, "we must enlarge our premises, and that we shall not do until we are thoroughly decided that the enterprise is to be a paying one. We have thirty-five men employed, forty miles of outside and a great deal of inside wire and engines of 730 horse-power. We supply 720 lights, each of 2,000 candle-power. It will easily be seen, therefore, that it takes engine power equal to that of about one horse to each light. I want to tell you that there are not the millions to be made by electric lighting which many people suppose. The light is a luxury, no doubt, but the prices not very luxurious when we take into consideration the tremendous expenses of the company. We employ numbers of men simply to make assurance doubly sure and prevent our customers from experiencing any trouble or inconvenience. These men are practically dispensable, but we are determined to retain them until experience will prove to us that the lights are in thorough automatical working order. This increases our burdens. In time we shall find out means of economizing, and this will tend to the success of the light. In this business increased demand alone cannot decrease price. If our orders double, so do our expenses. In trade a man's expenses do not increase so fast as his orders, but with us it is different."

THE COST OF ELECTRICITY VS. GAS.

"What would be the cost for twelve hours of the volume of gas necessary to produce a light equal to that for which you charge from seventy-five cents to $1?" asked the reporter.

"Roughly, about $17," replied Mr. De Camp; "but our light would not actually cover as great an area as the 125 burners would if properly distributed, but it would be their equal if they were placed in a lump."

"Is electric lighting looked upon with increased favor? Has your business increased greatly within the past year?"

"It has doubled in twelve months," Mr. De Camp rejoined with great satisfaction.

The manager of the Edison Company in Philadelphia said that their system was used throughout twelve large establishments in this city, although the office had only been running a year. In all, 4,000 lights were burned nightly in such places as the *Ledger* and *Record* buildings, Yates' clothing stores, John B. Stetson & Co.'s, Harris & Havemeyer's sugar refinery, and the Belmont Water-Works.

"Our customers find that their employes do better work than they did with the use of gas," he continued. "I am told that the *Ledger* and *Record* compositors, cheered by the electric light, do not grumble nearly so much as they used to. Compositors, you know, do grumble a good deal, but that only applies to those who work under gas. We have been very successful in lighting ships that have been built in Philadelphia, and the use of electricity on steamers is becoming very general. The great new Guion Atlantic steamer Oregon, which is expected to make fast time across the ocean, will be lighted by us, and also, I believe, the famous Arizona and the Alaska, of the same line.

PROGRESS OF THE LIGHT.

"I cannot tell you the minimum number of lights for which it would pay to have special machinery," he went on, "as it varies very much with circumstances. We have received statistics from manufacturers showing the relative cost of gas and electric light, and, in some cases, as much as half has been saved, laying aside the fact of the workmen enjoying better air and better light. Electricity must become more popular the more it is known. It is gradually being adopted. I believe that nearly every large flour mill out West burns it, as, with the light being in a vacuum and hermetically sealed, there is no possibility of a spark communicating."

"Have you many orders on hand for the light?" inquired the reporter.

"Orders!" exclaimed the manager; "why we have as many of them as we can fill."

He then showed the reporter a book of designs of most exquisitely and beautifully gotten-up chandeliers for electric light, explaining that as it was possible to invert the light, or place it at any angle, more telling effects could be produced with it than with gas.—*Philadelphia Press.*

To Get Electric Light Cheap.

WASHINGTON.—A company has been organized to utilize the water power of the great falls of the Potomac, and furnish cheap electric lights for public and private buildings in this city. The plan is to use the water power at the falls to drive the dynamo machines for generating the electricity, and then to conduct it to this city on large wires, which will have to be fourteen miles long.

The Electric Exhibition in Vienna is contributing indirectly to the popularity of Wagner's operas—popularity being measured, not only by the size of an audience, but by the number of those who cannot get admission. There is great felicity in the fact that a thunder and lightning composer like Wagner should have his memory kept green by an electric display.

A tower light is now being tried in the Horticultural Gardens, South Kensington. It is 110 feet high, and supports six Hochhausen arc lamps, 5,000 candle-power each. *Engineering* thinks danger is to be apprehended from the intense shadows.

Galvani and Animal Electricity.

[Abstract of lecture delivered by Prof. M'Kendrick, M. D., F. R. S., Professor of Physiology in the University of Glasgow, under the auspices of the British Association, at Southport, on the 24th ult.]

In these days, when electricity is commanding universal attention as a great force capable of being made subservient to humanity, it may be appropriate to consider some of the phenomena of electricity produced by living tissues and by living organs—or what is called animal electricity. We must also remember that most of the modern developments of electrical science may trace their origin to the physiological experiments of Galvani, the professor of anatomy at Bologna, in 1786. Struck by the contractions of frogs' legs in the vicinity of a frictional electrical machine, he wished to study the effects of atmospheric electricity, and accordingly made his first experiment. Then he discovered that there might be a contraction of muscle on the connection of the nerve and muscle by a heterogeneous metallic arc. Then came the notion that the nerves conveyed electricity from the brain and cord to the muscles, and, following the law that the new concepts of a man of science originate from ideas of familiar things, the muscle was forthwith compared to a Leyden jar, the inner surface of which became positive by nervous action, whilst the surface was negative. Motion was caused by the irritation of a kind of discharge, the positive, internal, surface being connected with the negative, external, surface.

Volta doubted this, and held that the phenomena observed by Galvani were due to very feeble currents of artificial electricity produced by the application of heterogeneous metals to the limbs of animals. In the critical inquiry made by Volta into this question, he was led to the invention of the voltaic pile, which not only for a time threw into neglect the question of animal electricity, but also was the starting point of the electrical science of the present day. In 1820 Oersted made the discovery of electromagnetism. This led to the invention of the astatic needle (ampere), and of the multiplier or galvanometer (Schweigger); and in 1827 Nobili constructed a galvanometer of great sensibility, by which he could reinvestigate the question of whether or not currents of electricity could be obtained from animal tissues. He found that such currents did exist, and he supposed they were due to thermo-electric action. About ten years thereafter (1837) Matteucci, of Pisa, again investigated the matter, and found that currents could be obtained from animal structures, even where all suspicion of thermo-electric or chemical action was removed. He also discovered that the interior of muscles was negative to their surface, and that it was possible to make a kind of battery of the thighs of newly-killed frogs, which could produce chemical effects similar to those caused by voltaic elements.

Then came the labors of Du Bois Reymond, the present professor of physiology in the University of Berlin, which will always mark the commencement of an epoch in the history of animal electricity. Recognizing that the detection of the feeble currents from animal structures depended on the delicacy and accuracy of the apparatus employed, he made many improvements in the construction of galvanometers, and in the arrangements for leading off the currents from living textures into the galvanometer. Such galvanometers must be exquisitely sensitive, and it is evident that just in proportion as they are so, so will be the difficulty of making an arrangement which will lead off any current that may exist, say in living muscles, without causing a current itself. If we apply to a bit of muscle the ends of the copper wires coming from a delicate galvanometer we either get no effect or an effect due to the action of the muscle substance, or the fluid covering it, on the copper wire. We must have some arrangement which, while touching the muscle, will not cause any chemical change in it, and at the same time will draw off into the galvanometer circuit any current that may come from the muscle itself. That is, the electrodes of the galvanometer must be *non-polarisable*, even when touching muscle. Du Bois Raymond found that little troughs of zinc, filled with a saturated solution of sulphate of zinc, fulfilled these requirements. Into these are placed bits of blotting paper, also wet with sulphate of zinc solution, and on the bits of blotting paper are placed morsels of clay moistened with saliva. When the bits of clay are put into contact so as to make a circuit, no current passes through the galvanometer. If we now take a muscle from the back of the leg of a frog, cut it across, and place it on the clay pads so that the section of the muscle touches one pad and the surface of the muscle the other, a current of electricity passes through the galvanometer, as shown by the swing of the needle. This was shown by the lecturer, a beam from a lime-light being reflected on a screen by a mirror attached to the needles of the galvanometer.

It was then shown that an uninjured frog's muscle gives no current; that no current can be got from two uninjured surfaces, nor from two transverse sections; but only, speaking generally, when one clay pad touches a section and when the other touches a surface. This may be called the muscle-current A similar current, though much weaker, can be obtained from living nerve. It was also shown that when a muscle is caused to contract, as it does naturally, the so-called muscle-current is diminished; at all events, suppose the current from a muscle brings the needle of the galvanometer to a certain point, if the muscle then be caused to contract the needle will swing back too nearly its zero point. This reverse—the so-called *negative variation*—indicates that an electrical change in the muscle happens when it contracts. But by refined methods of experiment it has been shown that this change really occurs *before* the muscle contracts, that is, the change in the electrical state of the muscle is an expression of the chemical changes occurring in it, which are antecedent to the muscular movement. The lecturer further showed how it was possible to measure the amount of those changes by Poggendorff's method of compensation, by which a fraction of the current of a Daniell cell was passed through the galvanometer in the reverse direction to the muscle current. Thus, it may be determined that the electromotive force of the natural current of a frog's muscle is about $\frac{1}{2}$ of a volt. Similar currents may be obtained from nerve, although they are very much weaker Much discussion has taken place as to what these currents really mean; but the majority of physiologists agree with Hermann, of Zurich, in thinking that the current obtained on cutting or injuring the muscle or nerve is really due to the dying of the muscle or nerve substance at the point of section, and that the so-called "negative variation" is the current indicating functional activity. That is, living substance dies at the plane of section, and in dying it acquires a lower potential than the living matter, thus giving rise to a current. Again, suppose a living muscle giving no current on stimulating it, by irritating its nerve, so as to cause the muscle to contract, a lower potential is produced at the points in the muscle where the nerve fibres end, and there is thus a negative variation. Further, it has been shown that this negative variation passes like a wave through the muscle substance, and that the wave has disappeared before the muscle contracts. If, then, electrical changes occur during the activity of muscle and nerve, it is natural that physiologists might expect to detect changes in the beating heart. This is the case. It was shown, by projecting its image on a screen, that the uninjured frog's heart isolated from the body still lives, and, whilst beating, gave with each beat an electrical variation, as shown by the swing of the galvanometer needle. The uninjured heart gives no current, but when slightly injured there is a variation in its electrical state with each beat.

Then the lecturer showed that light causes an electrical change in the eye. Placing the eye of a frog in the galvanometer cushions, it was shown that there was a current passing from the corner to the back of the eye. In the dark, little or no change could be seen except what might be due to the drying of the living structures forming the eye; on allowing light to fall on the eye, there was at once an increase in the current. This continued for a time, then began to fall off, and, on light being removed, there was another increase, and then a sudden and rapid fall off. This action, first shown by Professor Holmgren, Professor Dewar, and the lecturer, showed a specific influence of light on the retina. It could not be called a negative variation. It indicated chemical changes occurring in the retina. Lastly, the lecturer showed the production of currents from the living man. Placing the hands in two vulcanite troughs communicating by platinum plates with the galvanometer, and filled with a weak solution of salt, he showed that on contracting one arm a deflection of the galvanometer needle was produced. When both arms were quiet there was no current; on contracting one arm a current was at once produced. This current the lecturer was inclined to think was due to action of the fluid on the skin, and not to currents from the muscles, and that the differences were due to differences of contact.

In summing up, after a few remarks regarding electric fishes, the lecturer said that all of these electrical changes were really expressions of the vital changes occurring in living tissues under the action of stimuli. It was no part of the functions of nerves, muscles, or of the retina of the eye to produce currents under the action of their relative stimuli, but such currents indicated chemical changes in the organs or tissues. For example, the contraction of a muscle is a movement following or consequent upon many chemical changes, among the results of which were the production of heat and differences of electrical potential. Thus, there was no special production of electricity except in the case of electrical fishes, and possibly of some other animals. In most animals, including man, the production of currents was an incidental phenomenon indicating chemical operations and nothing more. Besides, the currents so produced were feeble and evanescent, and bore no relation to the general well-being; consequently, all attempts to influence the living body by magnets had no rational basis. The lecturer had tested this question by powerful electro-magnets, and had not been able to detect that they had the slightest influence on any vital phenomena.

It need hardly be added that the so-called phenomena of animal magnetism are of an entirely different kind from those discussed. These are of a subjective character, dependent on peculiar states of the nervous system, having nothing whatever to do with electricity or magnetism, but still in a sense they are phenomena as real as those of physical science. Their subjective character, however, renders them specially difficult of investigation, and consequently they are more liable to fall into the hands of the charlatan, One safeguard against this is the recognition of what the electrical phenomena of the living body really mean, and one purpose of this lecture will be served if it shows that to detect and account for these phenomena requires the most refined methods of the physicist and of the physiologist, and that they give us only a glimpse into the intricate changes occurring in living tissue. The lecture was fully illustrated by experiments in which galvanometers of the most sensitive construction were used.

The Connecticut District Messenger and Electric Company is nearly ready to begin operations in Meriden, the same as now in use here and in Hartford and New Haven.

A Vienna cabman has lighted his cab by means of an incandescent lamp. A dynamo, attached to the axle, generates current when the cab is running, which is stored in accumulators and used as required.

Electrical Standards.

On Friday, September 21, the report of the Committee on Electrical Standards was read in the section of Mathematical and Physical Science, London. The author, Mr. R. T. Glazebrook, explained that the original B. A. units had been compared between themselves, and the mean had been taken as the standard. Several resistance coils had been submitted for examination, and had been returned with certificates to the effect that they had been compared with the B. A. units, and that at a deg. Cent. the resistance equaled p. B. A. units, or p^1, Rayleigh ohms (1 B. A. unit = .9867 Rayleigh ohms). The coefficient of variation for temperature was not stated, as it could be determined by any electrician for himself. The original standards were single units, and during the year other standards of 10, 100 and 1,000 units had been made from them, under special precautions as regards accuracy, which he described in detail. He also stated that Dr. Muirhead had completed three air condensers as standards, and that the committee asked to be reappointed.

Professor Oliver Lodge then described a case of rapid diffusion of molten metals, which had been related to him by Professor Chandler Roberts, and upon which a paper was read by the latter.

Sir William Thomson made some remarks upon the discovery, which will be found appended to the discussion of the paper—"On the Magnetic Susceptibility and Retentiveness of Iron and Steel," by Mr. J. E. Ewing. The author said that he had been experimenting in Japan on the effect of stress in relation to magnetization, and he had demonstrated the hitherto unsuspected fact that soft iron is capable of an immensely greater degree of magnetization than steel. The method employed was to subject wires to the magnetizing force, tapping them during its application and withdrawing it gradually. When this plan was followed, 93 per cent. of the charge remained. He had obtained magnetic intensity of 1,590 units, while Thalen only obtained 40 from soft Swedish iron, and Roland 200. This result, Sir William Thomson said, was a satire on our knowledge of magnetism. The author also stated he had computed the heating effect of the reversal of the induction in iron in absolute measure.

Professor Fitzgerald read a paper in which he discussed whether the loss of energy by radiation from alternating electric currents would be practically negligable in the case of such currents as are used in alternating dynamos. The question arose in connection with Maxwell's theory that light may be due to varying electric displacement currents, and it seems to be of importance only when currents are dealt with alternating at a rate almost comparable with the rates of vibration of light. For instance, even with a million vibrations per second, there would not be any sensible loss owing to this cause.

In speaking of some spectroscopic appliances, Professor Shuster exhibited a rotating spark-holder which could be adjusted by the observer at the eye-piece of the instrument, and thus allowed spectra of different bodies to be brought into the field of view in rapid succession. He also exhibited a modified simple form of Mermet and Dichand's fulgarator, for the examination of spectra of liquid bodies.—*Engineering, London.*

The Properties of Hydrogenized Platinum.

The *Ann. Phys. Chem.*, vol. 19, pp. 300–319, contains a paper by C. Fromme on this subject, of which the following abstract appears in the *Journal* of the Chemical Society for September:

The author was led to suspect that the peculiar phenomena observed when platinum is the positive pole in a chromic or nitric acid battery were possibly due to the property of this metal of absorbing and of condensing hydrogen. He has accordingly examined the electric properties of platinum and palladium when containing hydrogen. Before the experiment, the palladium was freed from traces of oxide and of hydrogen; the

measurements of E.M.F. were made with open circuit. The ratio of the E.M.F. of the Zn—Pt to the Zn—Pd element was found to be 1 : 934. The first form of the experiment adopted to determine the electric properties of hydrogenized platinum and palladium consisted in introducing the metals into sulphuric acid saturated with hydrogen. Under these conditions the E.M.F. of the Pt | H_2SO_4 element had a constant value of .71 Daniell, while that of the Pd | H_2SO_4 element was at first .92 Daniell, and then it slowly decreased. The difference in behavior the author explains by the readiness with which platinum condenses hydrogen on its exterior surface, while palladium absorbs the hydrogen into its interior. In other experiments the metals saturated with hydrogen were introduced into sulphuric acid, free from gas; the E.M.F. of the combination Zn | H_2SO_4 | Pt was about 18 per cent. less than the same combination with the pure metal. After eight minutes the difference was only 8 per cent. In the case of palladium the E.M.F., after a polarization of short duration, reaches a minimum value of .75 Daniell. The author further examined with a rheostat the E.M.F. of the combinations Zn | H_2SO_4 | Pt and Zn | H_2SO_4 | Pd (the acid and the metals being free from hydrogen), and established that the relation of the E.M.F. to Pt and Pd decreased from 1.07, and then increased to 1.14, when the resistance decreased from ∞ to 0; if the resistance of the rheostat be ∞, then with greater resistance in the circuit the E.M.F. of the Pd element is the greater, but with less resistance the E.M.F. of the Pt element is the greater.

The author then proceeds to offer an explanation of the phenomena of the variation of the E.M.F. in the chromic and nitric acid batteries. The well-known property of palladium of absorbing hydrogen is sufficient to account for these variations, but in the case of platinum the evidence is not so clear. When a Grove element is first closed, a layer of hydrogen gas appears at the surface of the metal, but it subsequently disappears. This hydrogen is subject to two opposing forces, the one from the nitric acid tending to oxidize the hydrogen, the other from the platinum tending to condense the gas upon the surface of the metal, and of absorbing it into its interior. If at the outset the platinum contains no hydrogen, then the latter force preponderates, and to a greater extent the more dilute the acid, and the greater the intensity. With a greater concentration of acid, or with less intensity of current, these conditions are reversed. Sometimes the platinum condenses a portion of the hydrogen, while another portion is oxidized by the acid, and as a necessary consequence the E.M.F. falls; when it reaches a minimum, then the thickness of the hydrogen layer no longer increases, and all the gas is oxidized by the acid. As soon as the hydrogen condensed on the surface begins to combine with the platinum molecules on the surface of the metal, then the E.M.F. increases in proportion as the attraction of the hydrogen for the platinum decreases, while that of the hydrogen for the oxygen increases. The E.M.F. never attains its former value, on account of the hydrogen absorbed by and combined with the platinum. During the opening of the circuit the E.M.F. suddenly rises until it reaches a maximum; while the hydrogen on the surface of the metal is oxidized, and the combined hydrogen is separated off. Shaking the platinum causes the hydrogen to be given off from its surface, while a rise of temperature of the acid diminishes the evolution of the oxygen. The effects produced by these changes in the conditions will act in an opposite direction. The similar phenomena observed in the chromic acid battery cannot be attributed entirely to the absorptive power of platinum for hydrogen. The author supposes that the chromium sesquioxide, the product of the oxidation of the hydrogen by the chromic acid, forms a compound with the platinum. This supposition is not based on any facts, but it appears to the author that no other explanation is sufficient. When the combination

Zn | H_2SO_4 | H_2CrO_4 | Pt

is closed a portion of hydrogen is oxidized, while another portion, the quantity of which is dependent on the intensity of the current, is taken up by the platinum, as no hydrogen is evolved in the free state. The chromium sesquioxide partly combines with the sulphuric acid, and partly forms a combination with the platinum, and this latter causes the decrease of the E.M.F., which again increases when the evolved hydrogen turns out the chromium sesquioxide, and in its turn combines with the platinum.

Intellectual Decadence of Cities.

Boston is not alone in suffering a downfall from its intellectual supremacy. The day is past for provincial centers of national intelligence. Edinburgh has been deposed like Boston from a rank yet more exalted. Weima has sunk to be a petty residence town. Geneva has gone into trade and politics. Florence is no more an intellectual center. Oxford and Cambridge retain no dictatorship in letters. It may seem to be only a transfer of the intellectual headship from one locality to another. The change may be supposed to be nothing but an instance of the common law of the rise and decline of local greatness. London may be deemed simply to have taken precedence of Edinburgh, and New York of Boston. The process is no such mere process of local substitution. The intellectual exaltation of Edinburgh had much more in it of Edinburgh than the intellectual dominion of London can ever have in it of London. The character of Boston tinged the literary influence of Harvard more deeply than New York will be traceable in the literature which may there plant its local residence. Intellectual autocracy when it shifts its quarters to a center like London or New York, migrates that it may be independent of its locality. The intellectual sceptre is in course of departure from Boston because literary decrees dated from Boston could not but savor of Boston.

America desires that its literature should appertain to America at large. New York has no power to pass through any medium it can provide American literature and intelligence, although they happen to be lodged within it. A metropolis which has become a metropolis from the spontaneous tendency of the national forces and energies to breathe and circulate through it, attracts national intelligence by its very inability to reflect anything more narrowly local than the nation itself. Not a little is lost when a town like Boston slips from its literary supremacy. Whether held in commission by a score of cities from New York and Boston to Chicago and St. Louis and San Francisco, or engrossed by New York alone, the charm of American literary society gathered about Harvard cannot be reproduced. It will soon be a memory, like the tradition of Edinburgh of the age of Jeffrey and Scott and Wilson. They who witnessed and partook of it as it was when Longfellow and Lowell and Homes discoursed on poetics, and Emerson on humanity and Carlyle, should congratulate themselves on an experience which cannot be repeated.

Yet the literary decadence of Boston may mark for America the close of a period of intellectual pupilage. Crude and rough as is much of American intellectual activity, the dissemination of intellectual activity everywhere is indisputable. Literary experiments of magnitude obtain publishers and readers in other towns than Boston. Elaborate researches are conducted in more than one American city. Dean Liddell and Dean Scott acknowledge their obligations to America for ripe Greek scholars reared elsewhere than at Harvard To Boston itself dethronement or mediatization will not be an unmixed affliction. Uneasy lies the head that wears a crown, especially a literary crown. The brows of many worthy citizens of Boston must frequently have ached under the duty, imposed by the world's identification of them with their refined townsmen on the common or transcendental neighbors at Cambridge, to speculate more beyond their depth than the most intricate transactions in spermaceti oil or tanneries would ever have required. The whispers of the oaks of Dodona must at times have troubled prosaic Epirotes with a sense of the burden of maintaining an air of solemnity in proper dramatic accordance with the genius of their locality. Now that the literary fellowship of Cambridge has closed its list of members, and other American universities have grown as learned as Harvard, and other American publishers as enterprising, the average New Englander is not bound to be thoughtful in excess of his natural gifts. He can always remind New Yorkers that the press of Boston is as classical, at any rate, as that of New York, and that Boston devours more literature.—*London Times.*

Edison is sometimes reproached with having invented in the phonograph a mere scientific toy. But other useful inventions have likewise been mere toys at first. Professor Lankester said in his presidential address before the British Association that "the microscope, which was a drawing-room toy a hundred years ago, has, in the hands of devoted and gifted students of nature, been the means of giving us knowledge which, on the one hand, has saved thousands of surgical patients from terrible pain and death, and, on the other hand, has laid the foundation of that new philosophy with which the name of Darwin will forever be associated."

A Trip with an Electric Boat.

On Saturday I went for a trip with the electric boat on the Danube Canal. There were about thirty of us, and the excursion was most successful. The boat makes about six miles against the current, which is very strong on the canal (about six miles per hour), and eighteen miles with the stream, giving an average speed of about twelve miles per hour. Seventy-eight Sellon-Volckmar elements supply the current to an ordinary Siemens dynamo, which is directly fastened to the shaft carrying the screw. No vibration and no perceptible noise were to be noticed on the boat, and the motion was very steady and smooth. It is a pity the Electrical Power and Storage Company did not set up a water-wheel in the Danube Canal to charge their accumulators; it would have been a very pretty experiment, and certainly successful, as the current is quite strong enough.—*Vienna Correspondence London Times, September* 17.

The Electric Light in Boston.

The Merchants' Electric Light and Power Company has purchased of the American Electric and Illuminating Company its extensive plant and business in the city of Boston, including its contracts with the city, with the Massachusetts Charitable Mechanic Association, Foreign Exhibition Association, the New England Manufacturers' and Mechanics' Institute, and all of its contracts with business houses, hotels, railway companies and others who use the light regularly. The sale by the American Electric and Illuminating Company to a separate and new organization is necessitated by the fact that it has become exclusively a constructing company, requiring the entire and undivided attention of its executive officers and expert force to manage its rapidly growing business. The development and popularity of the Thomson-Houston system has increased so rapidly that the American company is pushed to its utmost capacity to supply the demand made upon it for machinery in New England. The Merchants' Electric Light and Power Company will enter upon an established business, with the necessary apparatus and facilities for furnishing over 550 lights, now in use in Boston, and with orders for nearly an additional 100 lights. The possibilities of its business can hardly be estimated. It is calculated, however, that this company can very easily rent 1,000 lights in Boston within twelve months from now. The rental of the lights which the present plant affords will yield large profits on the capital. The company has $100,000 of its capital stock in the treasury, from the proceeds of which additions will be made to the plant, which will increase in the same ratio. Its earnings and dividends, assuring at a very moderate estimate, after making the most liberal allowance for running expenses a dividend of 10 per cent. per annum.

In order to meet the demand for lights called for by contracts now in hand, the company will increase its plant at once, and accordingly offer a block of the treasury stock at par of $10 per share.

The stock is issued full paid and non-assessable. The directory of this new company is made up from among the most able, energetic and reliable business men of Boston, men of push and enterprise, and who will make it one of the best paying investments on the market. If the history of the American Electric and Illuminating Company, with the large dividends which it has paid its stockholders is any criterion to go by, we may predict for the new company a most prosperous future. At any rate it starts out under most favorable auspices, and the wise investor will now improve his opportunity and purchase some of the stock while he can purchase it at par.—*Boston Post.*

A new electric arc lamp, the invention of Mr. F. L. Willard, has appeared at the Fisheries Exhibition in London. The novelty consists in the device for holding and releasing the pendulum which controls the fall of the carbon

The apparatus for the electric light that is to illuminate Oaxaca, Mexico, has arrived in that city.

The electric lamps in Merida, Mexico, were lighted for the first time on the 7th instant, giving the best results.

Twenty lights have recently been added to those on the principal plaza in Guanajuato, Mexico.

Deserving Popular Support.

It is not often that we give an opinion upon topics outside of the field covered by the ELECTRICAL REVIEW. We are now tempted to step aside for a moment from the beaten track to say a word about our neighbor and much-esteemed contemporary, *The New York Times.*

Quite recently this journal was reduced in price from four cents to two cents, and we have watched the result of this movement with not a little interest.

The more one reads *The Times* the more respect he has for those who conduct it. It is a newspaper in the broadest sense. It prints the news as it is, without coloring and without unnecessary verbiage, and its editorial comments upon the same are sensible, well-digested, and, above all, just.

But there is a something about *The Times* which still more strongly commends it to the general reader, and which should give it a high place in the estimation of all honest men, the poor and rich alike. It never truckles to the rich, it has no interests to serve save those of the public, it is absolutely independent of all political influences, and rigidly adheres to sound political and economical doctrines.

Alone and single-handed, it fought and finally brought to justice the members of the Tweed ring, though, as is well known, it was offered hundreds of thousands of dollars in cash and still more in patronage to keep silent.

The Times believes that it is for the people and not for a newspaper to name candidates for political preferment, withholding the right to discuss the merits of such candidates when they shall be named.

The reduction in the price of *The Times*, we know of our own personal knowledge, is regarded with great satisfaction by many intelligent persons who, knowing that it properly represents the vital principle of republican government—the equality of the whole people—would long ago have liked to see it in the hands of every honest workingman.

We tender to *The Times* our hearty congratulations in its new departure.

Telephonic.

A Proposed Union of the Eastern Companies and Boston.

A meeting of the directors of the various New England telephone companies under Lowell management was held last week to consider important projects by which to increase their power for doing good and making money. An attempt to learn from them the proceedings of this meeting, in order that the readers of the *Times* might have the earliest possible advices of any movement which might be contemplated, was met in all cases by courteous yet decided refusal to give any information. We would like to tell you all about it, but we are under certain bonds of secrecy with the American Bell Company which prevent us from telling our doings until a certain point shall be reached. Well, of course no exceptions could be taken to that. We wouldn't ask anybody to violate a pledge, even to keep our readers posted on this matter, which may concern the interests of the many among them who are telephone stockholders. But despite the reticence of the directors, we feel that we can state without violating any confidence and without misleading the public, some facts, or at least the skeleton of some facts, as to the new projects under discussion.

A scheme has been proposed, and meets with much favor among the directors, to unite all the eastern Lowell organizations in one powerful company on a six per cent. basis, absorbing the Boston exchange now managed by the Bell company, on the basis of its earnings—the latter company taking a certain per cent. of the stock in the new company and waving dividends upon it for a certain period. Plans were not fully matured, but the directors will undoubtedly have something of this kind to submit to a meeting of stockholders which is to be held on the 17th inst. A union of this nature would have great possibilities of future business in it, as it is believed that the service of the Boston exchange might be greatly improved and the business increased by the Lowell managers, as has been the case in other cities. In view of certain hopeful experiments now being made with long distance transmitters the possible value of Boston as a telephone center can hardly be over-estimated. The Lowell men have long been ambitious to control that city, on account of the large amount of extra territorial business of which it is the center, and the consequent intimate relations it has with the companies now under Lowell management. The *Traveller* says that the feeling on the Lowell stocks is certainly better than for a long time past, and the outlook for a very material improvement at an early date is most excellent.

Telephone Exchange Changes in New Orleans, La.

The Southwestern Telephone Company have contemplated removing their exchange from its present locality adjoining the Cotton Exchange to one more eligible ever since they acquired possession of the telephone business in New Orleans. Several buildings were inspected by the agents of the company with a view to purchase, but none seemed to suit the purposes of the company except the three-story brick building situated at the southeast corner of Poydras and Carondelet streets. After some delay the company, through Mr. H. M. Robinson, real estate agent, came to terms with the owners of the building, and last week they commenced to move the wire, etc., into their purchase.

The situation of the building is in every respect a desirable one, and the premises themselves much more convenient, roomy and accessible than the quarters on Carondelet street near Gravier.

Important changes will be made and the service will be improved in every respect. The new company will leave no stone unturned to make the telephone service in New Orleans the most complete and satisfactory in the South if not in the country.

The Magnetophone.

The following account of an experiment on the effect of a rotating perforated disc on the magnetic field is from the pen of Prof. H. S. Carhart, of Evanston, Illinois, who calls the instrument, the magnetophone :

The experiments of Bell, Preece, and others, on the radiaphone, suggested the possibility of interrupting, or as least periodically modifying, the lines of force proceeding from the poles of a magnet by means of a disc of sheet iron, perforated with a series of equidistant holes, and rotated so that the holes should pass directly in front of the magnetic pole. It is well known that the armature placed on the poles of a permanent magnet diminishes the strength of the external field of force by furnishing superior facilities for the formation of polarized chains of particles from pole to pole. This is the case even when the armature does not touch the poles, but is in close proximity to them. If a piece of sheet-iron be placed over the poles of a magnet without touching, and magnetic curves be developed on paper above the iron, they will be found to exhibit less intense and less sharply defined magnetic action than when the sheet-iron is removed. If, however, a small hole be drilled directly over each magnetic pole, the screening action of the sheet-iron is modified in much the same way as when a hole is made in a screen opaque to light, for the developed curves show distinctly the outline of the holes. If, therefore, the sheet iron in the form of a circular plate, pierced with a number of holes, be rapidly rotated between the poles of a magnet and small induction bobbins, the action of a magnet on the core of the bobbins will be periodically modified, because of the passing holes, and hence induced currents will flow through a circuit including the bobbin. A disc of sheet-iron was pierced with two circles of ¼ inch holes concentric with the disc, the number of holes in the circles being thirty-two and sixty-four respectively. On one side of the disc was placed a horse-shoe magnet, with its poles very near the rows of holes on the other side were arranged two corresponding induction bobbins. The circuit was completed through a telephone and either bobbin at pleasure. Upon rotating the disc rapidly a clear musical sound was produced in the telephone, the pitch rising with the rapidity of rotation. Moreover, the bobbin opposite the circle of sixty-four holes gave the octave above the other, and each gave a note of the same pitch as was produced by blowing a stream of air through the corresponding holes.

A New Electrical Device.

One of the most interesting exhibits at the Vienna Electrical Exhibition is Gentilli's glossograph, a little instrument by which speech is automatically reproduced as soon as it is uttered. A small apparatus is placed in the mouth of the speaker—in contact with the roof of his mouth, his tongue, and lips—and on being connected with an electro-magnetic registering apparatus, the sounds are committed to paper. It is constructed in such a manner as not to cause any inconvenience to the speaker; neither is it necessary that the voice should be raised, as it reproduces a whisper as exactly as a shout; the only condition is a correct and distinct articulation. According to the inventor's calculation, it will be possible to write four or five times as fast by means of the glossograph as has hitherto been possible even by the quickest writer. At first sight it appears as if this invention was but an improvement upon Edison's phonograph; it is, however, of a much older date It rests, unlike the former, on an acoustic principle, and does not reproduce the sounds in a microscopical form. The chief obstacle to the introduction of the glossograph will be the difficulty in deciphering the characters; but is not impossible that with the help of a second automatic apparatus the characters produced by the glossograph may be translated into our common type-writing. The orthography would doubtless appear strange, but in these days of phonetic spelling this might not long be a hindrance.—*Pall Mall Gazette.*

Some of the Wonderful Apparatus at the Vienna Exposition.

The telephone in its manifold varieties and shapes, constructed according to this or that inventor, is to be found in almost every nook and corner of the building, says the correspondent of the London *Telegraph* at the Vienna electrical exposition. In one of the galleries eight curious looking, gayly decorated, windowless little huts have been erected, communicating to the outer world by a thick, heavy door, which closes hermetically. The interior is lighted from above. The telephones attached to the walls communicate with the Imperial Opera House, whence the sound is conducted through subterranean wires for a distance of four or five miles. A few nights ago an experiment was made in this department, in the presence of his Imperial Highness Crown Prince Rudolph. "Aida" was being performed at the opera. The soft tones of "O celest Aida" and the clang of the trumpets in the triumphal march were transmitted with a precision and clearness probably never yet attained in any of the similar experiments heretofore made. Other wires connect the telephone huts with the popular concerts given every evening in Vienna, so that by crossing over from one of these musical dens to the other we may be transported from the melancholy wail of a Wagnerian funeral march to the merry strains of one of Strauss's waltzes. In the British section, one of the greatest of electrical inventors, Sir William Thompson's syphon-recorder and mirror instrument, is exhibited by the Eastern Telegraph Company. This delicate apparatus, now so well known in scientific circles, is used not only in the offices of the company itself, but over the entire globe wherever extreme refinement and accuracy are required.

The French postal and telegraphic department has sent to Vienna the tasteful kiosk made for the Paris exhibition of 1881. It is placed on a platform immediately opposite the principal entrance. Under the flooring are 1,200 or 1,500 cells, composing the powerful batteries required for the ingenious apparatus displayed. Here may be seen telegraphy perfected, apparently, to the utmost limit. Not only is the language of man conveyed over thousands of miles in a few seconds, but his very handwriting, and the drawing he puts on paper, are transmitted letter for letter and line for line from one point to another. The French War Office exhibits complicated instruments for measuring the speed of projectiles, for the exact estimate of the force of recoil of guns and rifles, etc. The navy, the colonies, the departments of commerce and public instruction are all represented. Among other curious instruments is an electric scale, invented by M. Becquerel, dispensing with the use of weights. The amount of electro-magnetic force necessary to keep the needle of the scale at its center corresponds on a dynamometer to the weight. Dr. Boudet, of Paris, contributes scientific apparatus of much importance. In medicine sound is of infinitely more diagnostic value than sight. Acting on this principal, Dr. Boudet has applied the telephone, or, more accurately speaking, the microphone, to instruments which heretofore transmitted but imperfectly to the observer's ear those sounds that invariably accompany many organs of the human body in their functions, and which in their slightest variations impart much information to the experienced physician. Dr. Boudet has now invented a stethoscope so delicate that the murmurs heard with each beat of the heart are transmitted with the greatest accuracy, rendering perfectly appreciably the most trifling deviation from the normal; the soft, breezy sound of the air passing through the minute tubes of the lung cannot undergo the slightest change without being easily detected by the instrument. Dr. Boudet's sphygmophone records the flowing of the blood as it rushes through the arteries, and his myophone renders audible the crisp, crackling sound caused by a muscle as it contracts. Altogether the French exhibition is a most complete and remarkable display of the innumerable applications of electricity.

The Van Rysselburghe System of Simultaneous Telephony and Telegraphy.

Herz *vs.* Van Rysselberghe.

This case, which has been before the courts in Brussels for about a year, is now, we are informed, finally decided. It arose out of a negotiation for the purchase of some of M. Van Rysselberghe's earlier telephonic patents, which fell through. After M. Van Rysselberghe had signed the contract for the sale of the whole of his patents to Mr. Langdon Davies, Dr. Herz asserted that he had a prior right to purchase the patents, and brought this action against Van Rysselberghe for specific performance, and also for four millions of francs damages. The Court of Premier Instance gave judgment against Herz, and condemned him to pay the costs. The Court of Appeal also gave judgment against Herz, and condemned him to pay all costs, and also compensation for all damages resulting from the litigation. The effect of this decision is to establish Mr. Langdon Davies' position as owner of all the patents throughout the world. *Fiat justitia.* —*Electrical Record, London.*

Purchase of Telephone Patents.

PHILADELPHIA, Oct. 12.—The long pending negotiation between the Globe Telephone Company of New York, and the Shaw Telephone Company of Chicago, has finally been completed, and the Globe Company now becomes the owner of the patents for the United States, formerly owned by the Shaw Company.

At the Vienna Electric Exhibition a Mr. Abdank showed a magneto call, consisting of a permanent horse-shoe magnet, between whose arms a movable coil attached to a handle can be made to vibrate. These vibrations are electrically transmitted, and can ring a bell at a distance of 230 miles. A correspondent says that nothing simpler and more effective could be conceived, and the call strongly recommends itself for telegraph and telephone stations.

A telephone line is to be constructed in Victorio, Tamaulipas, Mexico.

The list of subscribers to the Atlanta, Ga., telephone exchange, H. H. Jackson, manager, has 283 names upon it.

The Erie Telephone Company began to open extra territorial lines in Texas last August, and returns just received indicate earnings of $1,600 that month from this new class of business.

Aurora, Illinois, and Ogden, Utah, are lighted by electricity produced by water-power. In the latter city the machinery is four miles from the town. It may be inferred from this that the water power in the neighborhood of some Mexican cities could be used with profit to develop electricity which might be used for lighting and mechanical purposes. The electricity may be conveyed as cheaply from long as short distances, and may be economized by means of storage batteries. In the many places in Mexico where fuel is scarce electricity promises to be of great general utility.

The stockholders of the Electric Light and Power Co., Boston, last week elected the following directors: William Moneypenny, E. T. Mithoff, A. G. Patton, W. B. Hayden, A. D. Rodgers, S. A. Barton, and T. P. Gorgon. The board elected the following officers: President, E. T. Mithoff; Vice-President, William Moneypenny; Secretary and Treasurer, J. G. McGuire. The company will immediately place one hundred lights in position, after which it will proceed to permanently locate its works to furnish private parties with the light.

Telegraphic.

The Annual Statement Showing the Condition, Resources, and Business Transacted by the Western Union Telegraph Company.

The annual report of President Green, of the Western Union Telegraph Company, shows the company to be in a very flattering condition financially. The company holds securities in various telegraph, telephone, and other companies, the marketable value of which is now over $10,000,000, and according to the report most of these securities are appreciating rapidly in value. These securities do not represent stocks of telegraph companies leased to the Western Union Company, most of which are owned by it, aggregating some $12,000,000 more.

The company has 432,726 miles of wire and 12,917 offices; 44,581,177 messages were handled during the year, the receipts from which were $19,454,902.08, against $17,114,165.92 last year. The expenses for the year just closed were $11,794,553.40, leaving a net profit of $7,660,349.58.

The report calls attention to the growth and increase of the property and business of the company since July, 1866. During this period the lines have been increased fourfold with nearly six times as much wire facilities and six times as many offices handling seven times as many messages, earning three times as much gross revenue, and making threefold as much net profits in one year.

Notwithstanding that the average rate per message to the public has been reduced from 81.04 % in 1866 to 38 cents in 1883, the past year exhibits an increase of 13,234 miles of line, or about 10 per cent., and of 58,358 miles of wire, being 15½ per cent. over the previous year, while the earnings show an increase of $2,340,937.06, or about 14 per cent., and the net profits an increase of $542,279.58, or about 8 per cent. over the year preceding.

The increase of $1,793,457.58, being 18 per cent. in the gross expenditures, is because of rentals paid for the American cables, the Cuba cables, and the Gold and Stock Telegraph Company (all the rentals paid by the company being charged in current expenditures), whilst these rentals were paid for only a small portion of the preceding year.

The percentage of cost of operating the land lines of the company has been steadily reduced. The company is pursuing the policy of steadily reducing the rates to the public, and has extended the rate of 25 cents per message to and from New York City, until that rate covers a larger area than is embraced in the whole of Great Britain.

The net earnings for the year were over 9 per cent. on the capital stock above fixed charges, and this the management believe will be considerably increased for the current year.

In conclusion, the president congratulates the stockholders on the successful ending of litigation against the company, and says it only remains to be determined to what extent the persons who have maliciously tried to embarrass its operations and depreciate its property can be held answerable to the company for the loss and damages it has thereby sustained.

The following board of directors was elected, 624,170 shares being voted upon out of the total 800,000 :

Norvin Green,	Hugh J. Jewett,
Thos. T. Eckert,	J. Pierpont Morgan,
John T. Terry,	Frederick L. Ames,
John Van Horne,	John Hay,
Augustus Schell,	William D. Bishop,
Harrison Durkee,	C. P. Huntington,
Jay Gould,	George H. Roberts,
Russell Sage,	Frank Work,
Alonzo B. Cornell,	Samuel Sloan,
Sidney Dillon,	Erastus Winans,
Cyrus W. Field,	John J. Astor,
Jno. Pender, M. P.,	George J. Gould,
Henry Weaver,	Chauncey M. Depew,
Percy B. Pyne,	James W. Clendenin,
R. Lenox Kennedy,	Christ. C. Baldwin.

The changes are John Hay in place of E. D. Worcester, and Frank Work in place of Z. G. Simmons.

The Board of Trade on Government Telegraphy.

At the quarterly meeting of the Montreal Board of Trade, held this week, the question of the assumption by the Federal Government of the entire telegraphic system of the country came before it among other important subjects. With much propriety under the circumstances the declaration was distinctly made the other day that the question was not then mooted by the Board in consequence of any hostile animus against existing private companies, but solely because the time is believed to have come when the Government should monopolize this branch of correspondence as it has long since done with postal matters. Nor will the Board of Trade make any suggestions whatever to the authorities at Ottawa as to the mode in which the proposed new system should be inaugurated. It is tacitly understood that no injustice will be inflicted on existing interests, and for the rest there is plenty of outside experience to serve the Government as a useful guide. In the United Kingdom and elsewhere in Europe the principle has been tried and profitably and otherwise satisfactorily solved. This revived suggestion of our Board of Trade is but the echo of the opinions expressed by the public, through the press and otherwise, during the existence of the late ill-weighed strike of the telegraph employes. At that time the public outcry for the change again just asked for at the quarterly meeting in question was loud, emphatic and all in one direction – that, namely, of a proprietary interposition on the part of the Dominion Government. The frequency and loudness of this demand naturally abated with the removal of the irritating cause of its existence, but the strength of the feeling itself has by no means changed. Public opinion continues as strong as ever in favor of governmental telegraphic control, as is directly proved by the renewed clamor of the press in its favor, and incidentally by the action of the Board of Trade of this city and elsewhere. The Government is sustained by too powerful a majority in Parliament to make it at all accessible to public clamor on this or any other question. But in yielding to such a demand, as we trust it will, it would not only increase its popularity but introduce a revolution which has already been altogether too long withheld.—*The Shareholder.*

Editor Electrical Review:

In my correspondence with Prof. Bell, published in the ELECTRICAL REVIEW of Aug. 23, 1883, I stated that my first plan of Musical Telegraphy was worked out on a telephonic basis, and as such was promulgated to the public. This fact is established by the annexed quotation from the *London Times*, and republished in this country in *Godey's Ladies' Book*, Philadelphia, March No. 1864 If we divest this quotation of its flippancy, we have a very good description of the distinguished scientist's (Prof. Bell) own electro-music, as it was exhibited in some of the Eastern cities. My own researches led me to the conclusion that telephonic music had more novelty than utility —that it never would benefit the art of music, but rather impair it ; so I dropped such plans, and worked out a system on dynamic electricity alone, by establishing an intimate electrical connection of musical instruments to be controlled by the skill and genius of one player for concert purposes.

It is true my telephonic appliances, in detail, may not be in harmony and perfection with the telephones of the day, although the principle of their operations may be the same. The original train of my investigation I followed on a physiological line. I associated the waves of sound with the current of electricity—that is, that the impression of sound could be carried by electricity, as it is carried by a nerve force. I could only in a measure follow out the anatomy of the ear ; but the instrument I constructed had its chambers, membranes, and for a propelling agent electricity, in lieu of a nervous transmission. The latter I looked upon as another order of electricity. In one experiment I adjusted the membranes in focal distances, within a short tube of the size and nearly the shape of the old-fashioned stethoscope. I spoke of this instrument in particular as a ready transmitter of sound in my lecture on Musical Telegraphy, delivered in Chicago, in the Crosby Opera House, April 10, 1869. This instrument I afterwards utilized for diagnostic purposes in my practice. In its use, I directed the patient to take one of the electrodes, I taking the other, the application of the instrument forming the connection. This instrument had four diaphragmatic membranes, and of course three corresponding chambers. Another interesting experiment (which in a measure I based on the action of the heart, making its impress on the most distal artery of the body) was tying a distended bladder to each end of the electric line, regardless as to length. One was firmly fixed to the back of a violin, or the sound-board of a piano, and the other was applied to the ear, at and considerable distance from the musical instrument. By this arrangement the transmission of sound from the instrument to the ear was clear and musical.

These and other experiments of like nature were made, but as they did not meet the real purpose under investigation, they were dropped. Had I pursued them for a different purpose, I might have had different results

It is important for me to state that in conducting these experiments, I had a reliable knowledge that sound could be conveyed a great distance by the aid of a proper conductor. I came to this knowledge accidentally. In 1847 I lived in Madisonburg, Pa. This village lies on a slight slope, and is supplied with water from the mountains by pipes. It happened that the feed pipes gave way, and the water throughout the whole length of the pipe, over a mile long, ran all out at its outlet. I applied my ear to this opening, and heard strange noises coming through the pipe. It turned out these were made by the men repairing the breach at the other end, over a mile away.

However, as my own statement alone, without the evidence of the press, would not fix my priority as being the first pioneer of this great invention, I will make the quotation referred to above in particular, for the satisfaction of those inventors of the telephone who have asked for the proof of my claim. A more explicit telephonic document, notwithstanding its unkind irony, could not be produced.

* * * "Have you heard, too, of the new American invention – musical telegraphy ? By means of it dulcet strains are to be laid on, like water or gas, at so much per annum for each house. A pianoforte is to be connected by means of electric wires with any number of instruments, and on being played, the sympathetic vibration will cause a regular stream of harmony to permeate every room in communication with the central depot. A distinguished professor is to be kept playing, and subscribers are to turn on music at will by means of a small tap. If this sounds a little mad, I can only assure you that it is a scheme gravely propounded by Mr. Hachenberg, an American gentleman who states his plans to be matured, and that he is ready to supply music at a given rate per annum to all the world. Fancy the sympathetic vibration between two kindred souls separated by an adverse fate, but who agree to enjoy the same sentimental strain at the same hour ! It sounds like a leaf out of the Arabian Nights ; but I am assured on scientific authority that the scheme is practicable, and that, with a proper number of subscribers guaranteed, it is perfectly feasible that the very best musical skill may be brought within the reach of all householders willing to pay a small additional rate. Does not Goldsmith's Citizen of the World, ask at a ball why the ladies and gentlemen go through all that hard work themselves, instead of paying servants to do it for them ? The labor of practising at the piano will, if this scheme succeed, be at an end ; for what young lady would have the heart to pound away at her 'Battle of Prague' when a professional player is competing with her in the same room, and when the superior strains of such player are constantly heard by the simple process of turning on a tap ?

"Let us suggest Shakespeare's line,

'Where should this music be ? i' the air, or the earth ?'

as an appropriate motto for Mr. Hachenberg's invention."

G. P. HACHENBERG, M. D.

Austin, Texas.

A telegraph line is to be built from Granada, Nicaragua, to the port of San Juan del Norte.

The Growth of the United States Since 1800.

According to the census of 1800 the population of the United States was little over that of Portugal. There were but two cities which had as many as 40,000 inhabitants, and four towns over 10,000 souls each. Seventy per cent. of the entire population lived in log huts twenty-five to thirty feet in length. Roads had not then been made through the primeval forests, nor was much known respecting the country beyond the Alleghanies. The Bey of Tripoli was the first, in 1801, to declare war against the young republic, for refusing to pay tribute, like the European powers, to the Barbary pirates. Hostilities with Spain occurred a few years later, ending in the annexation of Florida. France had been prevailed upon to sell Louisiana, just as in later years Mexico ceded California, and Great Britain the Oregon Territory. While pursuing a peace policy, the American Government always displayed great energy in making its flag respected, and exacted indemnities from Denmark, Naples, Spain, Portugal and France. In 1836 war with France seemed inevitable on the score of indemnity for injuries inflicted in 1805, but the French Government admitted the claim, and paid $5,000,000.

The various cessions of territory to the United States, and the prices paid, are shown as follows :

In 1776 Great Britain ceded thirteen States having an area of 421,000 square miles, at a cost of $75,000,000, being at the rate of 14d., or 28c. per acre—this was the cost of the war of independence. In 1803 France ceded Louisiana, area 46,441 square miles, for $15,000,000, or at the rate of 2c. an acre. In 1819 Spain gave up Florida, having an area of 60,000 square miles, for $5,000,000, or 12c. an acre. In 1829 there were annexed 123,000 square miles of Indian lands, for $27,500,000, or 36c. an acre. In 1845 Mexico ceded Texas, area 376,000 square miles, for $10,000,000, being at the rate of 4c. an acre. In 1846 Great Britain ceded Oregon, area 180,000 square miles ; in 1848 Mexico ceded California, with an area of 546,000 square miles, for $15,000,000, at 4c. an acre. In 1853 New Mexico was annexed, with an area of 46,000 square miles ; and in 1867 Russia ceded Alaska, having an area of 580,000 square miles, at the price of 2c. per acre.

It will be thus seen that from 1776 to 1867 the United States acquired 3,600,000 square miles of territory, at a cost of $155,000,000, he average cost being 6c. per acre.

The growth of population has been equal to that of territory ; viz :

	Whites.	Colored.	Total.
1800.....	4,304,500	1,001,400	5,305,900
1878.....	38,976,000	5,368,000	44,344,000

A sage who was on his weary journey to Wisconsin came upon a crowd one day, and observed a general sadness in all faces. "Why this gloom ?" queried the old man, as he laid down his bundle and felt for the front end of his plug of tobacco. "Oh, sage, we mourn the death of a good man," was the reply. "Was he honored ?" "He was." "Sober, upright, charitable and given to peace ?" "He was." "Who of you praised and encourged him in life ?" asked the old man as he looked around him. A hush fell on the crowd, and no one replied. "Praise that comes after death," whispered the sage, "does not even cut down the undertaker's bills. Better squander your time sawing wood for his widow." Moral : The widow will be expected to take in plain sewing to support herself.—*Detroit Free Press.*

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Practically Utilizing a Waterfall.

Long ago, and upon many different occasions, the ELECTRICAL REVIEW predicted that the time was not far distant when towns and cities lying adjacent to running streams would be lighted by electricity generated upon their banks without the interposition of coal or wood. Some of our contemporaries were inclined to view such projects as visionary, no doubt believing that we had arrived at our conclusions by a system of guesswork. Such, however, was not the case. The discoveries made by our own American electricians, the results of which we were familiar with, warranted the assertions we repeatedly made, and the various attempts made here and abroad to collect the power of running streams, each of which was more or less promising, confirmed us in our opinion.

It is not necessary here to refer to the splendid results of M. Deprez's experiments in France in the transmission of power to a distance electrically, because the project of which we are about to speak presents by no means so many difficulties. It may now be said to be an accomplished fact.

An electric lighting company, well known for its enterprise and success, has erected a generating station on the west bank of the Genesee River, at what is called the Lower Falls, in the City of Rochester, N. Y. Under these falls a series of turbine wheels are now being set in position. These turbines will be connected by pulleys and belts to a long line of overhead counter-shafting, from which the dynamos will be connected by belting. The building in which the machines are to work is 100x50 feet, resting upon a firm foundation of stone piers. The superstructure is spanned across its width at the base of the roof with nine trussed girders, which support the roof and the line shafting with its leading wooden-rimmed band-wheel, 5 feet diameter by 4 feet 8 inches face, and 18 pairs of fast and loose wood-rimmed pulleys, 42 inches diameter by 13 inches face each, making 360 revolutions per minute, and connecting by 12-inch belts with 18 dynamo-machines, arranged upon the floor near either side of the building, giving them 756 revolutions per minute at an expense of 40 horse-power each, making a total of 720 horse-power, supporting 720 lights, equal to 40 lights per machine or one light per horse-power.

It is contemplated to put nine more electric machines in the same building, to be driven by the same power, if such extra electrical power should be required. This would make twenty-seven machines in all, producing 1,080 lights and requiring 1,080 horse-power.

The turbines operate under ninety-four feet head of water, including the ten-foot draught tubes, and are estimated to make 582 revolutions per minute and develop 572 horse-power each, which, combined, equals 1,144 horse-power. The counter upright shaft makes 183.22 revolutions per minute, the counter horizontal shaft, with a ten-foot band wheel, 179 95 revolutions per minute; the main line shaft about 359.9 per minute, and the electro dynamos 755.79 revolutions per minute.

Of the success of the project to thus light the city of Rochester by means of the power formerly running to waste within its precincts, there may safely be said to be no doubt.

This goes far to prove that the mathematician is not likely to be called upon in the future to show that the electric light may not be economically generated away from the coal mines.

Already the electro-lighting companies have shown their ability to successfully compete with the gas companies, even when coal is used to work the generators. Certainly, now that the power of running streams may be utilized to light up towns, no one will question that the prospects of gas as an illuminator being succeeded by electricity, are very good.

The Holyoke telephone exchange has 375 subscribers on its list, an increase of 75 during the past year.

Electric Lighting Philanthropists.

It is but a short time ago that our esteemed but occasionally garrulous contemporary, the Boston *Evening Transcript*, made the discovery that the electric light (voltaic arc system) was a failure. There were, it said, two kinds of companies engaged in selling this light; one was made up of honest men, who, finding the whole thing a failure, were getting out as soon as possible; the other was composed of unprincipled men, who did not desire to sell the light, which would entail a loss, but sought only to sell the plant, on which the profits were great.

We thanked our contemporary at the time for this information—information, too, which should be looked upon as valuable, since it came from a source whence accurate scientific information is likely to proceed. Thus, when the public wants intelligence of scientific, more especially electrical enterprises, it does not look in the ELECTRICAL REVIEW and like publications, which are devoted to giving this information accurately and officially, but in the Boston *Transcript*. There, amid blood-curdling accounts, with minute details of the latest murder, the detection and arrest of the latest forger, and the reasons which prompted Patrick Murphy to knock his wife down with a stove lid, will be found now and then a somewhat limited but always accurate account—a sort of horoscope—of the electric light field. It does not pretend to give names and dates. It would not be trammeled by such vulgar details No! The editor simply brings what might be called his mental telescope to bear upon the electric lighting companies, and, after a careful study, untrammeled by facts, he finally arrives at the conclusion that they are shams calculated only to deceive the public; the lights bring in no revenue, are difficult to manage, and, were he to pursue the same line of argument a little longer with the same premises, he would, it is not unreasonable to suppose, prove that the lights didn't light up anything, and were therefore useless.

The *Transcript* said there are two kinds of electric lighting companies, which, as already described, consist in those made up of honest men, who, finding that there is nothing in the thing, are getting out of the business. The second class, it said, consisted of unprincipled men, who did not want to do any lighting, their only aim being to sell the plant.

Now, if we may be permitted, we would like to suggest to our esteemed contemporary another class which we have discovered; that is to say, after accepting as true, its own proposition. This class which we have discovered might not inappropriately be called electric-lighting philanthropists. Their business is to go about the country and light up cities and towns at a loss to themselves, and since the *Transcript* says: "The more lights they sell the more money they lose," the losses of these philanthropists must be enormous. Singularly enough, the number of these electrical philanthropists is almost daily increasing. Just think of it! Here is a perfect rush to see who shall have the opportunity to lose the most money!

We had been led to look upon the world of our day as given over to mercenary pursuits, where men struggled hand to-hand for gain; where the idea of a mutual benefit no longer prevailed, and where little was put forth without the anticipation of an immediate or at least not long-delayed return.

Therefore it is that we are now happily disappointed.

Here, right in the field in which we are laboring, is a crush of men anxious, if they cannot illuminate the spiritual environment of their fellows, to at least light up their streets gratuitously.

Chief among the electrical philanthropists is the Brush Company, the United States Electric Lighting Company, and the Thomson-Houston Electric Company. The limits of this article will not permit us to describe the amount of voltaic-arc lighting these companies are doing, nor how eager is the struggle between them to see which shall do the most—that is, according to the Boston *Transcript*, who shall lose the most money. We will content ourselves by a few instances. The American Electric and Illuminating Company recently bought at a high figure, from the Arnoux Company, the right to furnish Portland, Maine, and other cities in the vicinity with the electric light; and, not content with furnishing an immense number of arc lights in Boston, where, if the *Transcript* theory is correct, they must already have lost several millions, they are arranging to light up certain districts in New York on the same terms; the United States and Thomson Houston companies are making no less strenuous efforts to sell voltaic arc lamps, already having almost numberless strings of them aglow, and willing and anxious to sell many more—that is to say, to give them away; for, if our esteemed contemporary is right, that the honest men have left the business and the unprincipled ones won't sell the lights at all, these companies must be made up wholly of philanthropists.

Just look for a moment at the work of that choice body of philanthropists known as the Brush Electric Light Company. They have recently lighted up a whole city—Evansville, Indiana—out of pure benevolence.

We do not know but we take it for granted that these gentlemen wear tall silk hats with broad, flat brims, and are wont to surround their necks with heavily-starched chokers and black stocks, for this is our idea of the most approved form of philanthropist, and that these gentlemen are such we not unreasonably infer from the proposition of the Boston *Transcript* and the fact that they have signified their willingness, nay, their eagerness, to supply voltaic arc lights.

The Evansville authorities have repudiated the gas companies altogether, and have been so impressed with the electric light, both as to efficiency and economy, that they have refused to be longer troubled with the extortions and the treachery of the gas people. Unless they have seen the Boston *Transcript*, they have not yet learned that the Brush Company does not do business to make money, but to alleviate the condition of their fellow-men. When they learn of the generosity, not to say charity, of the Brush Electric Light Company, they might, not inappropriately, set up a tablet, electrically illumined, and with the following inscription:

"The Brush Electric Lighting Company—'*Amicus Humani Generis.*'"

Efficient and Valueless Steam Engines.

The recent improvements in both systems of electrical lighting, viz.: the incandescent and the voltaic-arc, have resulted in making both economical successes save under conditions which fortunately are seldom found. The result is that demands are coming in from all parts of the country for electrical installations, and the companies, as a rule, are so full of orders that they cannot begin to fill them even when working their shops overtime.

Improvements in the economical construction of these machines and in the distribution of the plant are being continually made, and what was once thought to be only an ingenious laboratory experiment, and so far as practical application was concerned, within the means only of the wealthy, has now been brought to a point of cheapness that makes it available for the general public.

Though it is even now possible and practical to operate the electrical generators by power collected from running streams favorable conditions of this nature are not always to be had, and the demand for efficient steam and gas engines is therefore great, and in the near future is likely to be very large indeed.

Therefore it is that we have become much interested in examining the various descriptions of engines manufactured in different parts of the country, and as the readers of the *Electrical Review* from one end of the land to the other are constantly looking to us for advice as to which are the most efficient engines, we propose to make some searching examinations in their behalf.

The importance of having good engines in the establishment of an electric lighting

plant cannot be over-estimated. We have seen, from time to time, installations for electrical lighting fail utterly because of the uneven movement and utter unreliability of the steam engines that were coupled to the dynamos. We have seen careful electricians devote all their energy toward making the electrical circuits and mains as perfect as possible, and pay little heed to the character of the engines which were expected to operate them.

How many thousands of dollars might have been saved, how many anxious moments and how much profitless endeavor might have been saved, if these men had but remembered that the engine-room is one of the most important adjuncts of an electrical light plant.

What would we think of an architect who should devote all his attention toward perfecting and embellishing the upper stories of his house, and leave the stability of the foundations to bunglers and mechanical slovens?

As said before, we propose to look carefully into the matter of engines, so as to protect our patrons from imposture. Those who are urging the claims of engines well fitted for being coupled to electrical dynamos will have nothing to fear from us, but those who are trying to hoodwink our electrical projectors, as well as all other frauds, may expect to be handled without gloves.

ELECTRICAL MEASUREMENT.

An Admirable Treatise by an Able Electrician.

THE SCOPE OF THE WORK—A FEW WORDS ABOUT ITS AUTHOR—THE THEORY AND PRACTICE OF ELECTRICAL SCIENCE—THE NECESSITY FOR JOINING THE TWO—HINTS TO ELECTRICIANS BY A PRACTICAL WORKMAN—THE ADVANTAGES OF A SIMPLE STYLE IN WRITING—VARIOUS DESCRIPTIONS OF WRITERS—ELECTRICAL MEASUREMENT AND THE GALVANOMETER—DIFFERENT KINDS OF INSTRUMENTS—THEIR USES AND DEFECTS EXPLAINED—OBSTACLES MET WITH IN PRACTICAL WORK—HOW TO OVERCOME THEM—HOW TO MEASURE THE RESISTANCE OF THREE WIRES WITHOUT USING A GROUND WIRE TO LOCATE A BAD JOINT OR OTHER DEFECT PRODUCING HIGH RESISTANCE — MEASURING THE ELECTRIC LIGHT.

It is rarely that so agreeable a task falls to our lot as that of reading and reviewing a book like that before us entitled "Electrical Measurement and the Galvanometer."*

Having had a long acquaintance with its author, Mr. T. D. Lockwood, than whom a more skillful, more trustworthy man in his line may not be found on this Continent, we expected to be both amused and instructed. In neither case were we disappointed.

As our readers are aware Mr. Lockwood has furnished to the REVIEW, almost since its inception, letters from various parts of the country, containing accurate and painstaking descriptions of the various telephone, telegraph and general electrical projects, explaining the technical construction of each, the obstacles met with in the same, and the means employed to remove them. As Mr. Lockwood occupies an important and responsible position under the American-Bell Telephone Company and is an expert both in theory and practice, these letters have furnished reading matter of an exceptional nature.

Many a telephone man and many an alleged telegraph expert, utterly bewildered because of some novel defect in his line, has read Mr. Lockwood's letters to this journal and found the means of repairing the defects and at the same time relieving his brains from further cudgelling. We wish we could add that they thanked Mr. Lockwood for the information or acknowledged to us their indebtedness to him. But candor forces us to avow that they did neither and our knowledge of them leads us to the belief that they are not likely to.

The reading of this treatise will bring to the minds of those who are familiar with technical work, many sensations. It furnishes good circumstantial evidence why the author has been so successful in that field in which he is a laborer. But we cannot help but think of the many industrious and intelligent men, who, while he was successfully encountering difficulties, fell hopelessly by the way. For it is the fate of those who toil at the higher employments of life to be rather driven by the fear of evil than attracted by the prospect of good, to be exposed to censure without hope of praise, to be disgraced by failure or punished for neglect where success would have been without applause and diligence without reward.

As inspector of telephone lines, Mr. Lockwood has been called to find the solutions of a continuous series of what might not inappropriately be called electrical conumdrums, and if his knowledge of other departments of electrical science is as accurate as that which he evinces in treating electrical measurement and the galvanometer, the success he has achieved is by no means surprising.

Mr. Lockwood's writing forms an agreeable contrast to that of very many of his fellow writers on electrical and other scientific subjects, in that he confines himself to simple language. He is one of those men who never say "commence" when "begin" will do, nor use the term "presume" when they want to say "think." The public reader will, we know, agree with us that this habit cannot be too highly commended.

Often the scientific writer makes his meaning so obscure that only those who possess the key are able to understand it, and we have seen ideas so beclouded with verbiage that like two grains of wheat hid in two bushels of chaff, you may search all day ere you find them, and then you discover they are not worth the search.

There is a species of writers whose labors counteract themselves. There is the writer of exuberance and copiousness, who diffuses every thought through so many diversities of expression that it is lost like water in the mist; the ponderous dictators of sentences, whose notions are delivered in the lump, and are like uncoined bullion—of more weight than use; the liberal illustrator, who shows by examples and comparisons what was clearly seen when it was first proposed, and the stately son of demonstration, who proves with mathematical formality what no man has yet pretended to doubt.

There is a mode of expression for which the masters of language have never yet found a name—a style by which the most evident truths are so obscured that they can no longer be perceived, and the most familiar propositions so disguised that they cannot be known. Every other kind of eloquence is the dress of sense, but this is the mask by which a true master of his art will so conceal it, that a man will as easily mistake his own positions, if he meets them thus transformed, as he may pass, in a masquerade, his nearest acquaintance.

In this little book before us the author would seem to endeavor to make clear his meaning in the fewest possible words and in the most direct manner, and as it is full of ideas and replete with accurate and practical information, we cordially commend its perusal to the general reader, whether he be an electrical engineer, a practical mechanic or a casual investigator.

As the author very truly says, there is no force of nature that is more subject to her unchangeable laws than electricity and many of those laws, and the measurements and testing methods depending thereon, are so exceedingly simple that a child may readily master them.

Every telegraph operator, he says, every telephone manager or inspector and every person engaged in any employment in which electricity is used, should be conversant with simple testing and measurements.

The galvanometer, the construction of which Mr. Lockwood so lucidly explains, may be compared with the apparatus for weighing substances, and the yard-stick or metre-chain for measuring surfaces. By its aid we may readily ascertain and compare the working strength and value of electric currents the resistance which electro-magnets, wires, and other conductors offer to the passage of the current, the electro-motive force or initial power and the resistance of batteries, and also will they aid us to localize line troubles and other circuit faults.

It is not intended to convey by means of this little book any very important information to experienced electricians—so the author infers from his index—but we are so far inclined to differ with the author in this as to suggest its perusal to just such a class, believing that they may obtain some practical hints which will be of great value to them. For the author has for years had almost daily practice in that part of electrical science he essays to treat, and his suggestions have been adopted by the most important and largest electrical company in this country.

On the other hand, students, operators and others will find within its pages what may rarely be discovered in the ordinary text-books, viz., simple explanations.

Listen to an extract from its index: "Whatever otherwise may be the faults of this little book, and doubtless they are many, it is the proud boast of both author and publisher that no algebraic equation appears therein, and that arithmetic has been found sufficient for the formulæ contained in its pages.

"Knowledge of the higher mathematics is such an invaluable aid in these processes that it is not surprising that those familiar with algebra and the differential and integral calculus should have availed themselves extensively of such an aid; it is however to be lamented that nearly all the text-books on this most important subject assume their readers to be proficient in mathematical knowledge and use mathematical symbols to explain or rather to disguise the most ordinary measurements"

We cannot say that we altogether agree with the author in this, though in the main he is undoubtedly correct.

But there are many discussions in electrical science which, though they could be greatly simplified for the perusal of those like Mr. Lockwood, skilled in the details of the subject, are rendered far more intelligible to those with a less extensive acquaintance with the subject, by means of the higher mathematics.

In a very interesting chapter on the galvanometer, the author says: "Although the ordinary galvanometer is very well adapted to detect the presence or indicate the direction of a current, and for some simple measurements, especially for those in which the deflection is not greater than fifteen or twenty degrees, it is not to be depended upon for any testing in which a greater deflection is produced for the following reason: That, when a needle is deflected, it is not in the same position on its coil as when at zero; the greater the deflection, the further is the needle moved away from the position where its coil most powerfully influences it, and the nearer the needle approaches the right angle, at which point the coil has no influence on it at all, the weaker does the action of the current become. In order to overcome this difficulty and for other mathematical reasons, galvanometers have been invented in which the tangent or sine of the angle of deflection is proportional to the strength of current measured."

The apparatus connected with the Wheatstone Bridge is very expensive, and therefore not in general use. An erroneous idea has also prevailed, says Mr. Lockwood, owing to the formidable display of figures and algebraic symbols to be found in the text-books when this simple apparatus and its uses are being explained. Thus the bridge has never been in that general use in this country which its merits would seem to warrant.

So far as expense of apparatus is concerned, the firm of J. H. Bunnell & Co., of this city, have succeeded in making complete sets of bridge apparatus, including galvanometer and all necessary resistances at a price which is within the means of all electricians. This firm of Bunnell & Co. would seem to be one of the first to recognize the fact that electricians are not, as a general thing, among the most wealthy of the land, and instead of insisting that electricians should be suited to the instruments they use, have very wisely essayed to make the instruments to suit the electricians or rather their purses.

The portable bridge apparatus of the Bunnell type consists of a galvanometer and sets of resistances arranged as a bridge system and a case in which both instruments may be placed. The galvanometer is, in the words of Mr. Lockwood, thus described:

"A delicate magnetic needle is lightly poised in pivots and carries at right angles to itself a light aluminum pointer, extending on both sides, over a dial having a scale graduated to degrees; the needle is surrounded by three coils of different resistances. The first coil, which is adapted for use in measuring high resistances or when weak currents are employed, is made of comparatively fine wire and has a resistance of seventy ohms. The second coil, which may be employed with medium resistances and currents has a resistance of thirty ohms, and the third consists simply of a metal band which passes once or twice round the needle and its resistance is so small that it may be ignored.

"Each coil," says Mr. Lockwood, "may be used separately or they may be used in series so as to constitute a continuous coil of 100 ohms."

The instrument itself is mounted in a brass case, with glass cover, and is set on a base of vulcanite or hard rubber which stands on three adjustable leveling screws. It is provided as are a certain description of pocket compass, with a clamping device, by which the needle when not in use is held in a stationary position so as to avoid injury.

The chapter of Mr. Lockwood's little treatise upon the comparison of different systems of measuring resistance and testing lines will be found of great interest, especially to those connected in any way with telephonic or telegraphic experiments, for it may be called the summing up of the author's experience.

The first method of testing lines and measuring resistance he says is by the angles of deflection of the galvanometer needle; the second by matching with a differential galvanometer, the resistances to be measured with other and known resistances, until the needle of the galvanometer shows no deflection; third, by the Wheatstone bridge or balance.

There are, he continues, two ways of using the first general method; the first of the sub-methods being that of substitution, the simplest plan in use, and any good galvanometer may be used when this plan is adopted.

The battery and galvanometer are placed in circuit with the resistance which it is sought to measure. The amount or number of degrees of deflection must be carefully noted and then replacing by a known, an unknown resistance, such, for example, as a rheostat, in which the number of ohms must, of course, be adjusted until the deflection of the needle is the same as before.

By this means the unknown resistance is found to be about equal to the known resistance, which has usurped its place.

A sine or tangent galvanometer is used in the second of the sub-methods. The relative strength of the current produced by the same battery in two circuits; the one, of course, having a known resistance, the other including that which is to be compared. Under these circumstances, the author says it is necessary either that we know the resistance of the galvanometer and battery, or that these resistances must be so small in proportion to the remainder of the circuit that they can be neglected without greatly affecting the result. The measurements by the deflection angles, he thinks, cannot be depended upon, when great accuracy is required. This is because of the variation of the electromotive force and the internal resistance of the battery while the measurements are being made. Deductions of battery and galvanometer resistances too, have to be made and this is apt to be somewhat bothersome. Such inconveniences are not found when the Wheatstone bridge or differential galvan-

* "Electrical Measurement and the Galvanometer; Its Construction and Abuses." New York: J. H. Bunnell & Co., Publishers.

ometer is in use, and the results are obtained by reason of the absence, rather than the amount of deflection. The Wheatstone bridge, he says, has proved in every respect the superior method for measuring resistance.

Mr. Lockwood explains the reader an ingenious means of measuring the resistance of three wires without using a ground wire. Here is his method: Suppose three line wires to be running between the same terminal stations. The resistance of all of them can be measured without an earth wire, and at the same time these measurements should be more reliable than were they measured as a grounded circuit, for the reason that errors arising from defective ground wires, as are those also likely to come from earth currents are avoided.

Now, suppose we number the three wires, 1, 2 and 3

In Mr. Lockwood's system, the first thing to do would be to join the distant ends of Nos. 1 and 2, and measure the loop. After assuming the resistance to be 4,000 ohms, Nos. 1 and 3 are in turn connected at the distant ends, and the second loop being measured is found, let us say, to have a resistance of 5,000 ohms; 2 and 3 being now looped, and the loop measured, we find a resistance of 8,000 ohms. From these results it is required to get the resistance of the three several lines.

"To get the resistance of No. 1," says Mr. Lockwood, "we add the first two results together, that is, the 4,000 and the 5,000 ohms; the sum is of course 9,000, which is clearly the sum of the resistance of all the wires, the first being doubled, as it was measured both times.

We now substract the third result from the sum obtained, deducting 8,000, the resistance of the loop, composed of Nos 2 and 3, and we find the remainder to be 1,000; this, divided by 2, because No. 1 was twice measured, gives us 500 ohms as the resistance of No. 1.

The resistance of No. 2 is similarly obtained; that is, by adding the first and third result, subtracting the second, and dividing by two; and is found to be 3,500 ohms. The resistance of No. 3 is likewise found by adding the second and third results, subtracting the first from the sum and dividing by 2, leaving the final result 4,500 ohms.

The calculation can be expressed in figures as follows:

Resistance of No 1

$$=\frac{4,000+5,000-8,000}{2}=500$$

Resistance of No. 2

$$=\frac{4,000+8,000-5,000}{2}=3,500$$

Resistance of No. 3

$$=\frac{5,000+8,000-4,000}{2}=4,500$$

In order to locate a bad joint or other defective point, producing a high resistance in a line circuit, short and intelligent directions are given by the author. He assumes for purposes of illustration a line whose resistance when in good working order is known to be about 3,000 ohms, but which owing to a bad or unsoldered joint, (supposed) loose instrument connections or four terminal ground shows a resistance of 10,000 ohms. Following is the process of correcting defect in line:

"Attach a ground wire to the middle of the line, and with the distant end open measure to the middle. If the bulk of the resistance is still in the half of the line measured the defect is between the middle of the line and the testing station; now have the ground wire moved to the middle of the half measured, and make a third test, and so on until the trouble is passed and the measured resistance makes a sudden fall from the last one; when this occurs, the defect is located between the last two measurements. If, on the contrary, on making the first test with the middle of the line grounded, the resistance falls to such an amount as half of the line would normally possess, the defect is evidently in the open half of the line, beyond the middle ground wire, and must be followed up until it appears on the testing side of the temporary ground once more. Then it is located between the last two temporary terminals."

Mr. Lockwood closes his very interesting little book with the directions for measuring the resistance of an electric light by the Wheatstone bridge apparatus, or by the use of a tangent galvanometer.

In dealing with such currents as those used in electric lighting, galvanometers of very low resistance should be employed and rheostats and resistance coils composed of very large wire; indeed, in some cases, as the author points out, it is convenient to use resistances of other material, such as carbon for instance. It has, he says been found of advantage to insert a relay in the cross wire—instead of first using a galvanometer—until the balance is so nearly established that the magnet does not seem to be affected. Even a fine wire galvanometer may then be safely substituted, and the measurement may be concluded more accurately; calculating the result by proportion the same as in the measurement of any other resistance. The use of a polarized relay will not only detect the passage of a current in the cross-wire, but also its direction.

New Books.

JUST PUBLISHED.—16mo., 176 pp., boards, 22 illustrations. Price, 50 cents. "Incandescent Electric Lights, with Particular Reference to the Edison Lamps, at the Paris Exhibition," by Compte Th. Du Moncel and Wm. Henry Preece; to which is added "The Economy of the Electric Light by Incandescence," by John W. Howell, and on the "Steadiness of the Electric Current," by C. W. Siemens. Preface.—Since the successful experiments of Edison in maintaining a steady light of low intensity have become widely known, a large number of systems have been brought forward by different inventors. The public interest in the growth of these inventions affords a sufficient explanation of the appearance of an essay like the present. The relative value of different systems of lighting for interiors, in regard especially to economy of outfit and subsequent power to maintain, will soon demand the attention of all residents of large towns. Appended to the review by Compte du Moncel of the results of international electrical exhibition are three essays, recently published in the *Engineering Magazine*, one on "Economy of Electric Lighting," by Mr. Howell, of Stevens Institute, and another on "The Dynamo Electric Current," by Dr. C. William Siemens, and a third by W. H. Preece, on the results of the Paris Exhibition. Also one volume, 8vo, cloth extra, 169 pages, 96 illustrations, $2.50. "Electric Lighting by Incandescence, and its Application to Interior Illuminations," a practical treatise, by Wm. Edward Sawyer. Contents: Introductory—Chapter I, Generators of Electricity. Chapter II. Generators of the Gramme Type. Chapter III, Generators of the New Siemens Type. Chapter IV, Incandescent Lamps. Chapter V, Carbons for Incandescent Lighting. Chapters VI and VII, New Forms of Lamps. Chapter VIII, Preservation of Incandescent Carbons. Chapter IX. Division of Current and Light. Chapter X, Regulators and Switches. Chapter XI, General Distribution. Chapter XII, Commercial Aspects. D. Van Nostrand, Publisher, 23 Murray and 27 Warren streets, New York. Copies sent by mail, post-paid, on receipt of price.

ELECTRICAL INVENTIONS.

Over Thirteen Hundred Patents for New Instruments Granted Last Year.

THE PROGRESS OF IMPROVEMENT IN THIS DIRECTION—THE PRINCIPAL INVENTORS.

Thousands of men are devoting themselves to the investigation of the phenomena of electricity. In the whole field of scientific research, discovery, and invention, there is no subject more fascinating, and none so full of promise of pecuniary reward as that of electricity. The progress that has been made in this field during the past few years has been marvelous, as everybody knows, and nowhere is this fact better illustrated than in the work of the electrical division of the Patent Office. From nothing it has grown in the period of a few years to become the most important in many respects in the whole office.

Mr. C. J. Kintner, chief examiner, has prepared a classified statement showing the work of the electrical division since its organization which is given below. The summary will be found to be of great interest not only to inventors, but to the public as well, in showing the special directions inquiry has been and is being turned. The summary is in a great degree self-explanatory:

Patents granted relating to electricity.	All to July, 1881.	July, 1881, to July, 1882.	July, 1882, to July, 1883.	Total.
Alarms	17	1	7	25
Alarms, burglar	80	15	8	103
Annunciators	89	10	9	108
Applications, general	31	18	23	72
Applications, tools and machines	58	8	18	84
Batteries, galvanic	155	18	25	198
Batteries, secondary	4	2	52	58
Batteries, secondary applications	3	17	12	32
Batteries, thermal	...	3	2	5
Bells	37	2	4	43
Boat steering	15	6	1	22
Car brakes	19	8	9	36
Circuit closers	33	3	5	41
Clocks	43	6	21	70
Condensers	5	....	1	6
Conductors	149	45	72	266
Connectors	31	6	13	50
Dental instruments	22	2	1	25
Electrolysis	192	7	6	205
Electro-magnets	39	5	1	45
Exploding	39	2	...	41
Friction generators	12	....	3	15
Gas lighting	156	19	14	189
Heaters	6	2	2	10
Incrustation	19	....	...	19
Indicators	39	14	10	63
Induction coils	33	....	4	37
Insulators	107	5	8	120
Keys	42	10	8	60
Lightning arresters	8	7	11	26
Lightning rods	154	8	9	171
Lights—arc	94	102	131	327
Lights—incandescent	54	72	92	218
Lights—system and appliances	44	73	78	195
Locomotion	2	5	7	14
Magnetic locks	10	....	4	14
Magneto-electric	87	64	107	258
Magnetro-electric hand machines	25	8	7	40
Meters	11	10	5	26
Morse registers	20	....	4	24
Motors	116	11	25	152
Music playing	8	1	..	9
Railway signals	139	28	39	206
Recorders	28	8	10	46
Regulators	68	14	73	155
Relays and sounders	112	25	8	145
Repeaters	30	2	2	34
Rheostats	6	1	3	10
Separators	38	10	12	60
Switches	32	8	11	51
Telegraph poles	23	2	1	26
Telegraphs	46	5	3	54
" automatic	111	10	8	129
" dial	23	....	1	24
" duplex	61	16	10	87
" dynamo	8	1	3	12
" fire	140	13	23	176
" multiplex	7	2	1	10
" perforating	26	....	7	33
" printing	191	8	18	217
" quadruplex	19	10	3	32
" railway car	22	4	15	41
Telephonic tele'phs, calls	61	33	13	107
" details	7	5	3	15
" electric	102	50	33	185
" magnetic	66	26	16	108
" mechanical	22	10	13	45
" radiophones	6	....	.	6
" reed	30	1	2	33
" relays & repeaters	4	7	1	12
" systems	103	72	78	253
Therapeutics, baths	33	2	2	37
" body wear	70	11	3	84
" electrodes	17	1	4	22
Thermostats	34	....	8	42
Transmitters	37	6	5	48
Underground lines	52	33	78	163
Total	3852	1019	1329	6220

The above only presents a part of the work of this single division, however, as letters patent are not issued to more than fifty per cent. of the applicants. Every one of the rejected or passed over applications is subjected to a careful examination, and cases that are reported upon adversely oftentimes are a source of almost endless dispute, appeals being taken from the lowest to the highest authority in the office. There have been in the past ten years not less than twelve thousand applications for electrical patents filed in the Patent Office, and the number is constantly increasing. Last year nearly three thousand applications were filed. Next year the number is expected to reach four thousand. Following is a list of the more prolific inventors, and the number of patents granted each from July, 1882, to July, 1883:

Edison	109
Weston	56
Brush	23
Thompson	15
Irwin	13
Starr, and S. & P.	12
Buell	11
Field	11
Scribner	10
Waring	9
Anderson	9
Van Depoele	6
Maxim	6
Connolly, &c.	8
Finney	11
Kitsee	9
Peck & Chapman	8
Seymour	7
Strohm	7

NEW PATENTS—ELECTRICAL—1883.

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING OCTOBER 9, 1883.

286,181 Secondary electric clock; Augustus S. Crane, Newark, N. J.

286,220 Insulating electrical conductors; Herbert O. Phillips, Waterbury, Conn., assignor to Holmes, Booth & Hayden, same place.

286,241 Dynamo electric machine; Sylvanus F. Van Choate, New York, N. Y.

286,242 Dynamo electric machine; Sylvanus F. Van Choate, New York, N. Y.

286,247 Armature for dynamo electric machines; Townsend Wolcott, New York, N. Y.

286,259 Process of forming electrodes for secondary batteries; Charles F. Brush, Cleveland, Ohio.

286,268 Electric signal for railway trains; Edward R. E. Cowell, Detroit, Mich., assignor to himself, Lewis Mann, E. C. Brown, and Robert Miller, same place.

286,273 Electrical synchronous movement; Patrick B. Delany, New York, N. Y., assignor to the Standard Electric Manufacturing Co., same place.

286,274 Electrical synchronous movement; Patrick B. Delany, New York, N. Y., assignor to the Standard Electric Manufacturing Co, same place.

286,275 Electrical synchronous movement; Patrick B. Delany, New York, N. Y, assignor to the Standard Electric Manufacturing Co., same place.

286,276 Electrical synchronous movement; Patrick B. Delany, New York, N. Y., assignor to the Standard Electric Manufacturing Co., same place.

286,277 Electrical synchronous movement; Patrick B. Delany, New York, N. Y., assignor to the Standard Electric Manufacturing Co., same place.

286,278 Electrical synchronous movement; Patrick B. Delany, New York, N. Y., assignor to the Standard Electric Manufacturing Co., same place.

286,279 Duplex telegraphy; Patrick B. Delany, New York, N. Y., assignor to the Standard Electric Manufacturing Co., same place.

286,280 Telegraph apparatus; Patrick B. Delany, New York, N. Y., assignor to the Standard Electric Manufacturing Co., same place.

286,281 Electrical synchronous mechanism; Patrick B. Delany, New York, N. Y., assignor to the Standard Electric Manufacturing Co., same place.

286,282 Telegraphy; Patrick B. Delany, New York, N. Y., assignor to the Standard Electric Manufacturing Co., same place.

286,350 Electrical stand lamp; Jonathan H. Vail, New York, N. Y., assignor to Bergmann & Co., same place.

286,397 Post for electric conductors; J. Allen Devlin, Philadelphia, Pa.

286,414 Dynamo electric machine; Geo. W. Fuller, Norwich, Conn.

286,415 Armature for dynamo electric machines; Geo. W. Fuller, Norwich, Conn.

286,416 Dynamo electric machine; Geo. W. Fuller, Norwich, Conn.

286,437 Support for electric wires and lamps; James V. Hirley, Cincinnati, Ohio.

286,445 Electric meter; Warren S. Johnson, Whitewater, Wis., assignor of one-half to William Plankinton, Milwaukee, Wis.

286,481 Electric gas-lighter; Theo. H. Parker, Boston, Mass., assignor of one-half to Charles E. and Frank Fuller, same place.

286,497 Magneto generator of electricity; James B. Stabler, Sandy Spring, Md.

286,529 Combined call-bell and fire-alarm system; Charles E. Buell, New Haven, Conn.

286,566 Protecting device for bank safes; Alvah Wiswall, Cincinnati, Ohio, assignor of one-half to Matthew Britton, same place.

Telephone Stock Quotations.

American Bell Telephone Company	209
Bay State Telephone Company	123
Central New York Telephone and Telegraph Company	101
Boston and Northern Telephone Company	135
Empire State Telephone and Telegraph Company	203
Granite State Telephone Company	95
Hudson River Telephone and Telegraph Company	110
Long Island and New Jersey Telephone Company	100
Mexican Telephone Company	2½
National Bell Telephone Company of Maine	90
New York and Pennsylvania Telephone Company	100
Northwestern Telephone Company	100
Southwestern Telephone Company	68
Suburban Telephone Company	139
Southern Bell Telephone and Telegraph Company	125
Tropical Telephone Company	3
Central Union Telephone Company	100
Iowa Union " "	100
Missouri and Kansas Telephone Co.	90
United Telephone Company (Kansas and Missouri)	89
Bell Telephone Company, of Missouri	165
Wisconsin Telephone Company	125
Cumberland Telephone Company	100
Great Southern Telephone Company	100
Michigan Telephone Company	115
Chicago Telephone Company	290
Erie Telephone Company	59

We shall give a full and descriptive account of the Cincinnati Telephone Convention in our next edition, which will be of more than ordinary interest to our telephone friends.

A license was issued on the 1st inst. to the Globe Electric Light and Power Company, Chicago, capital $600,000; incorporators, J. F. Rhodes, James L. Gage, and Francis E. Morse. A certificate of change of capital stock from $10,000 to $20,000 was filed by the Forest City Electric Light and Power Company, of Rockford.

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This device comprises a lightning arrester, cut out, and fusible wire, in a compact form, to be placed outside of the house or place of business of the subscriber; the electric current, by means of an arm extending inside of the building, being entirely cut off from the interior at the will of the subscriber, while fusible wires afford additional protection when the instrument is in circuit should an excessive charge, as from electric light currents, be accidentally thrown upon the telephone line. The advantages of this device are too obvious to need further comment. It is in successful use in Providence and other exchanges, and is in increasing demand wherever it has been introduced.

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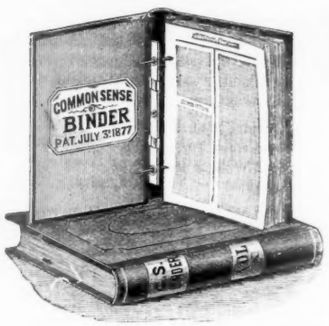

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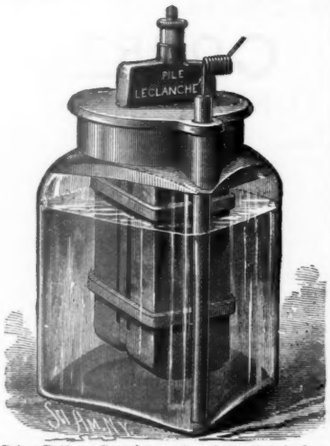

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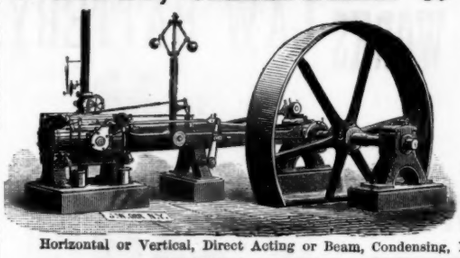

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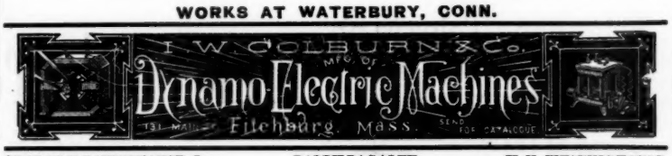

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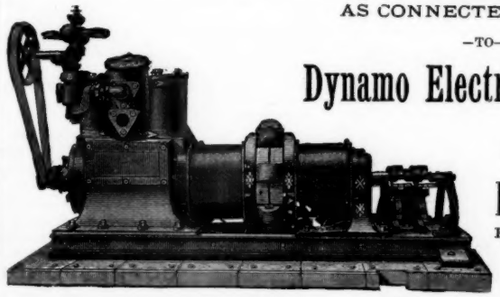

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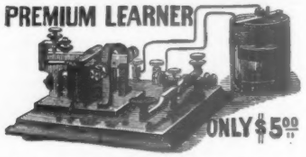

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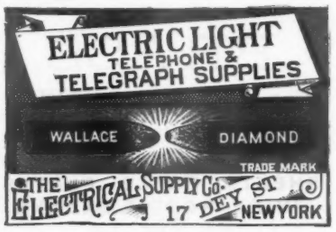

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(*Portland (Me.) Press, September* 19, 1883.)

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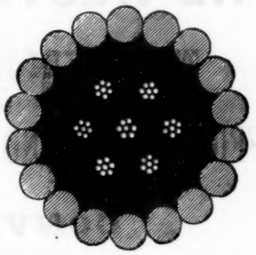

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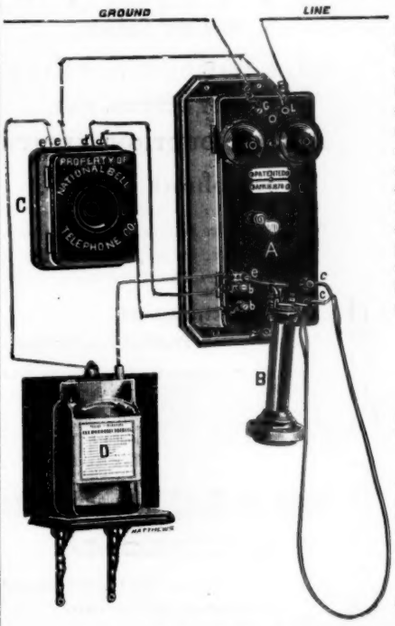

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